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PROFESSOR M'COY'S
CONTRIBUTIONS
TO
BRITISH PALÆONTOLOGY.

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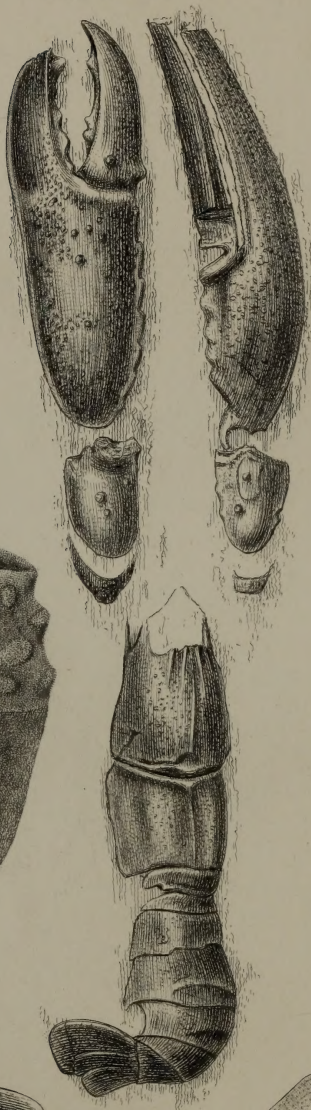
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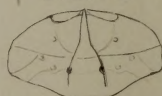
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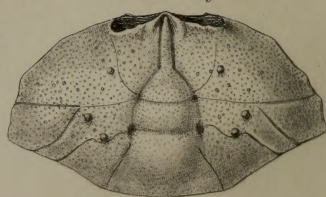
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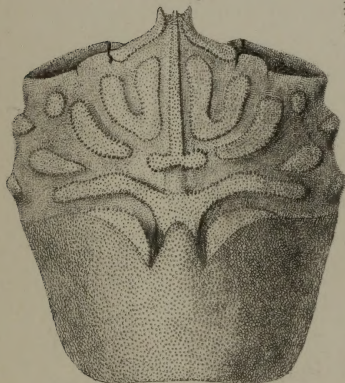
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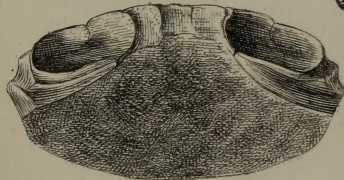
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CONTRIBUTIONS
TO
BRITISH PALÆONTOLOGY,
OR FIRST DESCRIPTIONS OF
THREE HUNDRED AND SIXTY SPECIES
AND SEVERAL GENERA OF
FOSSIL
RADIATA, ARTICULATA, MOLLUSCA, AND PISCES
FROM THE
TERTIARY, CRETACEOUS, OOLITIC, AND PALÆOZOIC
STRATA OF GREAT BRITAIN.

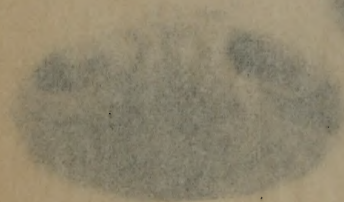
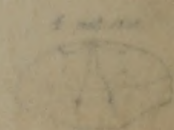
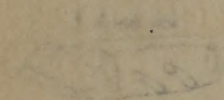
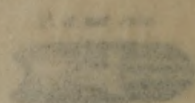
BY
FREDERICK MCCOY, F.G.S., HON. F.C.P.S.,
Professor of the Natural Sciences in the University of Melbourne,
Formerly Professor of Geology and Mineralogy in the Queen's University of Ireland,
Author of "Synopsis of the Carboniferous Limestone Fossils of Ireland,"
"Synopsis of the Silurian Fossils of Ireland," one of the Authors
of Sedgwick and McCoy's "British Palæozoic Rocks and
Fossils," &c.

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P R E F A C E.

THE following descriptions have appeared at intervals in the 'Annals of Natural History' during the last six years, and a small impression of the series of papers descriptive of new British Fossils is now published in a connected form for convenience of reference.

I originally intended to issue a set of Plates with this volume, but although several of the species are yet unfigured, illustrations of many others have appeared, since their original publication, in the volumes of the Palæontographical Society, and elsewhere by others, as well as in the Catalogue of the Cambridge Palæozoic Fossils by myself, and it was not thought desirable to add to the expense of the volume by incurring the cost of the large number of plates which would be required to illustrate the remaining species, principally from the newer rocks.

Cambridge, August 1854.

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CHAPTER I.*

FISH OF THE CARBONIFEROUS PERIOD.

M. AGASSIZ, besides the few carboniferous fish he has figured and described, gives a long list of manuscript names of fishes of this formation in the 3rd vol. of his 'Poissons Fossiles,' but being unaccompanied by any definitions or figures, it gives no information of the characters of the species, nor even secures their priority to the author; however, of the thirty unpublished species which he there names from the carboniferous limestone of Armagh, I have, through the kindness of Capt. Jones, R.N., M.P., been enabled to study the original specimens, and become well-acquainted with all except the *Cladacanthus paradoxus* and *Cricacanthus Jonesii*, of which I could learn nothing: admitting those twenty-eight then as already established, I can state that they are quite distinct from any of the following species.

I have great pleasure in acknowledging my obligations to Capt. Jones, not only for much valuable information on the fishes of this period, and access to his collections both in London and Dublin, but for the loan of many of the most interesting species described below, which I was thus enabled to draw and examine at leisure. To Mr. Griffith of Dublin I am also indebted for the loan of some interesting forms from the lower carboniferous shales of Ireland. The Rev. W. Stokes of Caius College, Cambridge, allowed me to select a large suite of new and interesting forms from his Armagh collections, and having given me the opportunity of drawing and describing them, they were deposited in the collection of that University, whence I have also described a few species from the Derbyshire limestones collected by Mr. W. Hopkins, F.G.S. &c. To the Rev. Prof. Clark of Cambridge, and also to Mr. Anthony of Caius College, Cambridge, I am infinitely indebted for the use of their magnificent microscopes, and for the kindness with which they took the

* The substance of this Chapter was read, and drawings of all the species exhibited, before the Cambridge Philosophical Society, June 5th, 1848. The species date from the 'Annals and Magazine of Natural History' for July and August 1848.

trouble to make microscopic sections for me of the new genera; without their most valuable aid I could not have presented the internal microscopic structure of those forms.

CÆLACANTHI.

Holoptychius (Ag.).

When we look to the large number of species of this genus now known in the old red sandstone, all characterized by thick, bony longitudinally plaited scales, and the largest of them having but small conical teeth, sulcated at the base, and then compare them with those large compressed teeth in the carboniferous shales, such as the *H. Hibberti* (Ag.), of which Prof. Owen formed his genus *Rhizodus*, and the nearly allied, if not identical, *H. Portlocki* (Ag.) of the Irish shales, with their associated large, thin, rotundo-quadrate scales having the minute reticulated structure of *Glyptolepis*, I think it would be desirable, instead of considering the genera *Holoptychius* and *Rhizodus* synonymous as they are now held, to retain both generic names, but restricting each to such forms as those above noticed. In this point of view the following is the only true *Holoptychius* I have yet seen from the carboniferous limestone.

Holoptychius Hopkinsii (M'Coy).

Sp. Char. Scales elongate, narrow, elliptically pointed, very thick, convex; exposed portion strongly enamelled, covered with numerous thick, rounded, slightly flexuous, anastomosing, longitudinal ridges; concealed smooth portion deeply bifurcate, generally bent laterally at a considerable angle with the exposed portion. Length of enamelled portion 6 lines, width 3 lines.

The thick, narrow form and strong longitudinal ridges of the surface distinguish this species easily from its congeners. It abounds in some parts of the black impure beds intercalated between the carboniferous limestone and overlying shale of Derbyshire, from whence the specimens described were collected by W. Hopkins, Esq., who presented them, with a suite of fossils from that district, to the University collection at Cambridge. I have great pleasure in dedicating it to one who, as a mathematician, and as an observer in the field, has so materially advanced the science of geology.

Isodus leptognathus (M'Coy).

I provisionally apply the above name to a dentary bone of a Ganoid fish apparently allied to *Glyptolepis*. It is destitute of

ornament, about 2 inches long and $3\frac{1}{2}$ lines deep at the broad end; it is slightly curved and tapers a little to a rounded extremity at the anterior end; the upper margin is minutely roughened and contains about thirty nearly equal teeth, nearly their own length apart, conical, about one line long and half a line wide at base; the upper portion is smooth and the base coarsely fluted as in *Rhizodus*, of which it also possesses the important internal character of the medullary cavity being conical and simple in the upper or smooth part of the tooth, and as it approaches the base abruptly branching into several root-like processes, one corresponding to each of the external flutings: from *Rhizodus* however the genus is distinct by the teeth being of nearly uniform size (not of *two* distinct sizes), and by the section of each tooth being circular instead of elliptical with cutting edges.

From the yellow sandstone shale of Moyheeland, Draperstown (Ireland).

(Col. Mr. Griffith at Dublin.)

Centrodus (M'Coy), n. g.

(Etym. κέντρον, *galli calcar*, and ὀδὸν, *dens*.)

Gen. Char. Tooth simply conical, gradually tapering, slightly curved backwards, apex pointed, section circular throughout; medullary cavity large, conical, simple, so wide at base that the tooth is reduced to a thin edge; surface even, very finely striated longitudinally. Microscopic structure:—exceedingly fine calcigerous tubes radiating directly from the pulp-cavity towards the periphery, near which they terminate in numerous very minute calcigerous cells, beyond which is a narrow clear layer bounded by a definite dark line, outside of which is a coating of glass-like enamel, without perceptible organic structure under a power of 300 diameters.

Externally these teeth slightly resemble *Rhizodus* (Ow.), but are distinguished by their circular section, and wide, *simple* pulp-cavity, which latter distinguishes it from nearly all palæozoic teeth except the old red sandstone genus *Cricodus* (Ag.), from which it is known by its more slender conical form, and wanting the strong longitudinal ridges of the surface, as well as possessing the distinctly defined enamel layer, which has all the appearance of having been secreted by a distinct organ, and is quite different from the condensed dentine which forms the false enamel of most fish-teeth.

Centrodus striatulus (M'Coy).

Sp. Char. Tooth about half an inch long and $1\frac{1}{2}$ line in diameter at base; conical, gradually tapering to the pointed apex, with

a slight backward curve; about one-fifth of the surface towards the apex perfectly smooth; the remainder, under the lens, is minutely and irregularly striated longitudinally.

This remarkable tooth, the only species I as yet know of the genus, seems to present all the characters, external and microscopic, of a true Saurian reptile; and when we compare it with Herman von Meyer's genus *Pistosaurus*; for instance, of the Laineckerberg Muschelkalk and other allied Saurians, the resemblance is such as to caution geologists against laying too much stress on the supposed first appearance of reptiles in the magnesian limestone, when drawing a line which would separate this group from the palæozoic rocks below.

Common in the bituminous carboniferous shale of Carluke, Lanarkshire.

(Col. Cambridge University.)

Colonodus (M'Coy), n. g.

(Etym. κῶλον, *ilia*, and ὀδὸς, *dens*.)

Gen. Char. Tooth elongate-conic, very gradually tapering, section round near the base, becoming trigonal towards the apex; front even, sides impressed with short, alternating, transverse, wrinkle-like furrows; enamel-like surface smooth, highly polished, longitudinally marked with few, distant, minute impressed striæ; it terminates obliquely at the base, the edge being slightly notched or wrinkled; base forming a short, slightly dilated round disc, placed obliquely to the axis of the tooth, and extending farther behind than in front, truncated below and of a coarse osseous texture: medullary cavity about one-third the diameter of the tooth, cylindrical, from which, under the microscope, the flexuous, distant calcigerous tubes are seen to radiate directly to the surface, towards which they become gradually finer and closer.

This tooth is not unlike a bit of small intestine tied at the end, being nearly cylindrical, smooth, glossy, and slightly wrinkled transversely along the sides. In general external character it approaches most to *Dendrodus* and *Rhizodus*, but is destitute of the longitudinal flutings towards the base, which are so intimately connected with the internal structure of those teeth; the *transverse* wrinkling of the sides is also a strong external difference. The fine longitudinal scratch-like striæ of the surface resemble what we see in the enamel of *Suchosaurus*, &c. It is its internal microscopic structure which most perfectly distinguishes it from its allies, for by its simplicity it is at once widely removed from *Dendrodus*; and from *Rhizodus*, which it most nearly approaches in structure, it is distinguished (besides the differences in ex-

ternal conformation) by the much greater coarseness of the calcigerous tubes, and the greater space of blastema separating them: the difference is still greater towards the exterior; for while, in *Rhizodus*, the coarse tubes of the dentine terminate abruptly near the surface, ending in a layer of minute calcigerous cells, from which the infinitely finer and closer, straight tubes forming the enamel-like surface take their origin; in *Colonodus* the loosely flexuous calcigerous tubes are four or five times their diameter apart, and as they approach the surface they gradually become finer, a little straighter, closer and more numerous; but there is no layer of cells, no abrupt line of separation between the coarse tubes of the body of the tooth and the fine ones of the surface. The simplicity of its microscopic structure, and the simple round base distinguish *Colonodus* from central cusps of *Cladodus* (Ag.).

Colonodus longidens (M'Coy).

As there is but one species yet known, it is not possible to separate clearly the specific from the generic characters. However, the specimen on which those observations have been made is an almost perfectly straight, cylindrical tooth, the apex being unfortunately wanting, but enough remains to show that towards the extremity the anterior face becomes flattened so as to give an obscurely trigonal section; there are two alternating rows on each side of about thirteen or fourteen short transverse furrows, forming between them obscure wrinkles; the whole surface to the naked eye seems smooth and highly polished, but under a low power the fine, impressed, rather distant longitudinal sulci become visible. The whole tooth seems directed backwards at a considerable angle from its round bony base, and the inferior termination of the enamel-like portion is therefore very oblique to the axis of the tooth, being considerably lower in front than behind, the edge seeming of considerable thickness from a sharp constriction being immediately under it all round, beneath which again the osseous base thickens to form a little peltate mass. The length of the portion preserved is 10 lines, width at base 3 lines, broken extremity at the above length $1\frac{1}{2}$ line.

From the red carboniferous limestone of Armagh.

(Col. Capt. Jones, R.N., M.P.)

PLACODERMI.

I provisionally propose to establish a distinct family under the above name, to include those Ganoid fish of the palæozoic rocks having the head and body encased in a series of odd or central, and of subsymmetrical or lateral, bony, variously tuberculated plates

of large size. It might probably include all the genera described by Agassiz in his 'Monog. du Syst. Dévon.' &c., under the title *Cephalaspides*, except *Cephalaspis*, to which that family-name might be retained, the other genera having no obvious affinity with it; in addition to these, the present group will conveniently embrace the genera *Bothriolepis*, *Asterolepis* and *Psammosteus*, which, although widely separated from the former by Agassiz and placed by him in his family of *Cœlacanthi*, are so obviously and closely allied to some of them (e. g. *Chelyophorus*, *Coccosteus*, &c.), that they cannot be separated either by general appearance or any points of structure with which we are acquainted; while they differ, on the other hand, from the other *Cœlacanthi* by the body not being covered by imbricating scales. The teeth are conical and plicated at the base.

Osteoplax (M'Coy), n. g.

Gen. Char. Dermal plates large, flat, osseous, polygonal, with straight sides; surface irregularly and minutely wrinkled, with scattered pores. Microscopic structure:—vertical section showing large, distant, cylindrical, branched, vertical tubes (? Haversian canals) terminating in the pores of the surface; the spaces between these tubes containing numerous oval bone-cells, rather more than their own length apart, from each of which short radiating branches extend on all sides, about six to the length of a corpuscle. Horizontal section:—large, circular, distant openings of the vertical tubes, with numerous intervening minute, radiated, Purkinjean cells, the tubuli of which do not anastomose with those of the adjoining cells in either section. One species.

Osteoplax erosus (M'Coy).

Sp. Char. Bony plates 1 to 2 inches wide and about 1 line thick; edges square; surface with close, short, irregularly flexuous smooth grooves visible to the naked eye, and with distant, irregularly scattered oval foramina.

The remarkable bony plates to which I have given the above name vary in the number of their sides and the amount of the angles at which they meet; but the sides are always straight, and the surfaces flat and of uniform thickness. It is clear, from their form, that they cannot belong to the head, but must be viewed as dermal bones, covering some part of the body of a mailed fish. Of known genera they can only be compared with *Psammosteus* of the old red sandstone, to one species of which, the *P. meandrinus* (Ag.), the resemblance is particularly close, but

the ridges of the surface are smooth in the present species and crenulated in the former. The two genera are well-distinguished by the internal microscopic structure, *Psammosteus* being composed of horizontal layers of large irregular cells, while *Osteoplax* has well-developed radiated bone-corpuscles.

Not uncommon in the schists belonging to the base of the carboniferous series at Cultra, Hollywood, county Down, Ireland. (Col. Cambridge University.)

Psammosteus granulatus (M'Coy).

Sp. Char. A thin, shagreen-like expansion closely covered with nearly uniform hemispherical smooth tubercles, less than half their diameter apart (two in the space of a line), the base of each surrounded by a circle of minute granules.

This is an irregular fragment of rough shagreen-like integument, measuring about $2\frac{1}{2}$ inches in length and $1\frac{1}{2}$ inch in width; it is exceedingly thin. The species is closely allied to the *Psammosteus arenatus* (Ag.) of the Riga old red sandstone, but is distinguished by the tubercles having no sort of linear arrangement, and the granules surrounding the base are proportionably larger and rounder, not seeming like stellar denticles as in that species.

The specimen is from the fine black shale of the yellow sandstone (or lowest portion of the carboniferous system) of Kesh, river Banagh, county Fermanagh, Ireland.

(Col. Mr. Griffith.)

Psammosteus vermicularis (M'Coy).

Sp. Char. Surface covered with very minute conical tubercles, about six in the space of a line, irregularly placed, but averaging their own diameter apart, isolated, or two, three or four confluent to form small, irregularly twisted, vermicular ridges; the sides of the ridges and base of the tubercles denticulated with angular radiations (as in *P. arenatus*).

The specimen described is a reniform, convex plate, rather more than half a line thick, 1 inch 9 lines long and 1 inch wide, most probably belonging to the side of the head; not exactly agreeing with any bone I know in shape, but most like an operculum. The under surface is smooth (except the nucleus), the outer surface closely sculptured as above-mentioned. This species has the crenulations of the *P. arenatus* (Ag.), but the irregular, minute, and frequently confluent granules of the *P. undulatus* (Ag.); it is most nearly allied to the latter species, but the asperities, besides being crenulated, are smaller, more irregular, and the confluent ones more twisted and vermicular. The minute microscopic

structure resembles that of *Psammosteus* generally, that is, four or five dense horizontal layers at the surface, beneath which the substance is composed of large irregular cells, about half their diameter apart, but irregularly arranged in the blastema.

From the yellow sandstone shale of Fallaghlooh, Maghera, Ireland.

(Col. Mr. Griffith at Dublin.)

Chelyophorus Griffithii (M'Coy).

The specimens to which I give this name consist of a small jaw-bone, resembling the glossohyal in shape, about $11\frac{1}{2}$ lines long, obtusely pointed at the anterior end, and gradually increasing to nearly 2 lines in depth towards the posterior extremity, which is abruptly acuminate or wedge-shaped; the upper edge shows seven or eight small, curved, smooth conical teeth, their length rather more than twice their width, and the distance between them rather greater than their length; the surface of the margin has three or four rows of slightly elongate, closely-placed tubercles; towards the middle and lower part of the bone the tubercles elongate into short ridges, arranged in lines, which meet at an angle of 45° along the middle of the side, the angle pointing backwards on the posterior half, and forwards on the anterior half, so as to have a confused rhombic space at the middle of the bone; all the ridges and tubercles are glossy, very closely placed, and finely crenulated at their margins. The second specimen is a bone probably from the side of the occiput, resembling the portions of *Chelyophorus Verneuili* (Ag.) in figs. 17 and 18. pl. 31a of Agassiz, Monog. Old Red, &c.; the granulation of the sculptured portion is rather more distinct, forming lengthened tubercles in one part and subparallel ridges in another, and all minutely crenulated on the sides. The sculpturing of the two specimens is identical in character, both with each other and with the old red *Chelyophori*, differing from the *C. Verneuili* principally in the crenulation of the side of the tubercles.

They are both from the lowest carboniferous shales of Cultra, Hollywood, county Down, Ireland.

(Col. Mr. Griffith at Dublin.)

Coccosteus? carbonarius (M'Coy).

Sp. Char. Mesial (ventral?) plate very narrow; sides converging at an acute angle, apex rounded; mesial keel obtusely rounded, height in the middle one-fourth of the width; surface closely covered with rounded polished tubercles, varying from one-fourth to one-half of a line in diameter (generally the latter), each surrounded at its base by a little, closely applied, milled,

or radiatingly sulcated collar ; the intervening flat space faintly striated, and generally traversed by a small, smooth ridge which winds irregularly between the more distant tubercles.

The character of the sculpturing determines the reference of this species to either *Coccosteus* or *Asterolepis*, but as no lozenge-shaped plate similar to the central inferior one of *Coccosteus* has yet been demonstrated in *Asterolepis*, I think the reference, with a mark of doubt, to *Coccosteus* is most correct, a view which is also strengthened by the small size of the tuberculation. The genus has not hitherto been found out of the old red sandstone. The specimen above described being perfect only at one end, might be taken for the pointed posterior extremity of the dorsal plate of a *Coccosteus* ; but as there is no indication of the little fossa invariably found near the termination of the mesial keel of that plate, it most probably belongs to the under side of the body. The prominent circle at the base of the tubercles, like the spine-basis of a *Cidaris*, strongly reminds us of the *Asterolepis speciosa*, but the tuberculation is very much smaller. The inter-tubercular salient line or ridge does not occur in any *Pterichthys*, *Coccosteus* or *Asterolepis* I am acquainted with. A second specimen, a portion of a flat plate from some other part of the body, shows the same size of tubercles and style of ornament, but rather more crowded in some parts and with wider spaces in others ; one or two of the tubercles also, instead of being smooth and polished, show a faint, flexuous radiating striation from the centre to the thickened milled base. The width of the ventral plate at $1\frac{1}{4}$ inch from the point is only 1 inch, the sides converging straight to the apex from this distance.

Both examples are from the carboniferous limestone of Armagh.

(Col. Capt. Jones, R.N., M.P.)

Asterolepis verrucosa (M'Coy).

Sp. Char. Surface of plates closely covered with prominent, oval, conical tubercles, averaging from one-third to one-half of a line in diameter, and less than half their diameter apart, each radiatingly sulcated from the apex to the margin, the deep sulci forming between them usually fourteen strongly defined, rough ridges from the apex, each of which is again divided by a short sulcus at its base ; tubercles abruptly defined from the flat surface on which they rest ; intervening surface with minute radiating striæ.

The specimen examined of this, which is one of the rarest ichthyolites of the mountain limestone, is an irregular fragment

about $1\frac{1}{4}$ inch long and 5 lines wide; it is impossible to suggest what part of the body it belonged to. The genus has not been recorded before in the carboniferous limestone.

From the same locality and in the same collection as the last.

PLACOIDES.

(*Ichthyodorulites*.)

Homacanthus macrodus (M'Coy).

Sp. Char. Spine about 8 lines long and 2 lines wide at base, slightly arched and tapering to a point; section compressed, trigonal; anterior face formed by a narrow rounded keel, posterior concave face bounded on each side by a larger rounded ridge, between which and the anterior keel there is on each side a still smaller rounded longitudinal ridge, the two posterior ridges on each side dichotomise near their base; of the two intervening spaces the anterior is rather wider and the posterior rather narrower than the ridges which they separate, they are concave and very slightly striated longitudinally; posterior face with twelve or fourteen very large, compressed, falcate teeth, alternating in two rows, the alternating bases touching, keeled on their convex edge, their length nearly equalling the width of the side of the ray at their base.

The small size, few ridges and great posterior teeth easily distinguish this from other rays of the carboniferous period, while the two latter characters equally distinguish it from the *H. arcuatus* (Ag.) of the old red sandstone. This genus has not been noted before in the carboniferous series.

Rare in the carboniferous limestone of Armagh.

(*Col.* University of Cambridge.)

Homacanthus microdus (M'Coy).

Sp. Char. Spine about $1\frac{1}{4}$ inch long and 2 lines wide at base; very slightly arched, gradually tapering; section ovate; anterior face formed of a narrow rounded keel, each side with two slightly flattened nearly equal keels, the posterior one dichotomous at its base; they are their own width apart, the intervening spaces being flat and marked with about three longitudinal striæ; posterior face with two rows of numerous, conical hooked teeth, their length scarcely one-fifth the width of the ray at their base.

The more slender form, flattened ribs and interspaces, and numerous small conical teeth distinguish this from the last, with which alone it is likely to be confounded.

From the same locality and in the same collection as the last.

Ctenacanthus denticulatus (M'Coy).

Sp. Char. Spine nearly straight, slightly curved towards the apex; length of naked portion $5\frac{1}{2}$ inches, length of the rapidly tapering base 2 inches, width near base 9 lines; section truncato-elliptical, sides slightly convex, front narrow, rounded; posterior face wide, depressed, concave at both sides, with an obtuse ridge in the middle, the lateral angles closely set with a row of numerous small, conical, downward-curved teeth on each, their own length apart; longitudinal ridges rounded, less than their own diameter apart (about four in two lines in the middle of the ray), they are a little wider at base than towards the apex, increasing in number downwards by dichotomy; the sides of each ridge are denticulated with sharp, recurved teeth extending halfway across the intervening spaces, the denticle of one side connected with its fellow on the other by a slightly oblique fold across the ridge, each pair being separated from that above and below by about the thickness of the ridge; near the posterior margin on each side are four or five ridges much smaller than the rest, crossed by oblique blunt tubercles.

This species slightly resembles the *C. crenatus* (Ag.) in its ornament, but instead of the short, close notches in the sides of the ridges of that species, this is distinguished by the more distant, tooth-like denticulation and narrow transverse plicæ.

Not uncommon in the dark shale (of the age of the yellow sandstone) of Monaduff, Drumlish, in the N. of Ireland.

(Col. University of Cambridge and Mr. Griffith.)

Ctenacanthus distans (M'Coy).

Sp. Char. Spine compressed, gently arched, very long, slender, tapering at the rate of only 3 lines in 5 inches; posterior face with two rows of numerous small, short, conical compressed teeth, slightly bent downwards, rather more than the width of their base apart; sides flattened with about ten or twelve close flattened longitudinal ridges of irregular width, the broadest occasionally subdividing as they approach the base, all the ridges crenulated by small tubercles, about double the thickness of the ridge from each other; those on the anterior ridges are transverse and slightly oblique, while those nearer the concave margin are smaller, and assume the appearance of lengthened, nodular swellings, as in *Physonemus*.

This is a remarkably long and slender ray; one specimen in the University collection at Cambridge, of which a considerable portion of the apex must be lost, measures six inches in length and only six lines in width at the broadest part near the base,

the broken distal extremity being three lines wide, which would probably indicate a further inch and half of length. The portion of the base inserted in the flesh is small and gradually tapering. I am not certain of the exact form of the section.

Not uncommon in the red limestone of Armagh.

(Col. University of Cambridge and Capt. Jones, &c.)

Gyracanthus obliquus (M'Coy).

Sp. Char. Dorsal ray nearly straight, about one foot long and one and a quarter inch wide at base; section heart-shaped, width two-thirds of the antero-posterior diameter; anterior face narrow, rounded; posterior face broad, concave, having near the apex a row of small hooked teeth on each side; sides slightly convex, marked with numerous very oblique crenulated ridges or rows of tubercles, which meet the anterior face at an angle of about 35° (those of opposite sides meeting at an angle of 70°); the ridges become gradually more oblique, smooth, and entire near the apex, they are about half a line in width, and slightly more than their own diameter apart. The line of separation between the ridged external surface and the finely striated part which enters the flesh is very oblique and with a slight sigmoidal curve.

This large ray is most allied to the *G. tuberculatus* (Ag.), from which it is distinguished by the much greater obliquity of the sculptured ridges, and the more compressed form of the section; the *G. Alnicensis* (Ag.) has ridges nearly as oblique as the present species, but they are smooth and entire instead of being strongly crenato-tuberculate.

Very common in the dark shale (at the base of the carboniferous system), supposed to be of the age of the yellow sandstone, in the valley of the Moyola, at Moyheeland, Draperstown, in the N. of Ireland.

(Col. Cambridge University and Mr. Griffith at Dublin.)

Physonemus arcuatus (M'Coy).

Sp. Char. Ray wide, much curved; longitudinal rounded ridges very numerous, about fifteen in the space of half an inch, less than their own diameter apart, dilated into rounded, smooth, bubble-like tubercles, which are nearly twice their diameter apart; the narrow sulci between the ridges have two or three obscure longitudinal striæ.

Distinguished from the *Physonemus subteres* (Ag.) by its much greater size, more numerous ridges and wide arcuate form.

Very rare: from the carboniferous limestone of Armagh.

(Col. Cambridge University.)

Asteroptychius semiornatus (M'Coy).

Sp. Char. Ray slightly arched, about 3 lines wide, and tapering at the rate of about 1 line in 1 inch; section much compressed, the sides being flattened, and the thickness about one-third the width; about eight narrow, longitudinal smooth ridges on each side, separated by flat spaces nearly twice the width of the ridges; all the spaces are marked with two or three obsolete longitudinal striæ, but only the anterior one on each side contains a row of irregularly placed tubercles.

This is more compressed and arched than the *A. ornatus* (Ag.), and differs besides in having but one row of tubercles on each side, while that species has a row in nearly every space.

Not uncommon in the Armagh limestone.

(*Col.* Cambridge University, &c.)

Erismacanthus (M'Coy), n. g.

(*Etym.* ἔρεισμα, a prop or stay, and ἄκανθα, a spine.)

Gen. Char. Spine of three divaricating portions,—1st, a large, compressed, finely striated base which entered the flesh; 2nd, a short, strongly compressed, rapidly tapering spine curved directly backwards, the sides marked with strong, smooth, longitudinal ridges, and having two rows of short downward-curved teeth on the posterior concave margin; 3rd, a peculiar prop-like portion extending directly forwards nearly at right angles with the base, gently arched downwards, compressed at the basal half, depressed at the distal half, closely covered with blunt, smooth, oval tubercles, and with some large, irregular spines on the under side; the portion of the base above the flesh and from which those two portions branch, is irregularly tuberculated.

The long anterior prop or stay-like branch renders this ichthyodorulite so unlike any described form, that I should have hesitated to describe it, but for the number of examples which I have recently examined. Something slightly analogous I observe in the articulation of the spines of the recent fish allied to *Synodontus*, in which a shorter but similarly curved and directed prop-like process may be observed, but which is concealed beneath the soft parts and not external as in the fossil. I know but one species of the genus, which I have great pleasure in dedicating to Capt. Jones, R.N., M.P. &c., who is in possession of more extensive and exact knowledge of the fossil fishes of the mountain limestone than I believe any other observer. It is to his acumen in recognising the true characters of the species, zeal in collecting, and liberality with which both his cabinet and infor-

mation are made available to those studying the subject, that we are mainly indebted for the extended lists which have been published of the Ichthyolites of this formation.

Erismacanthus Jonesii (M'Coy).

Sp. Char. Posterior spine little more than twice as long as wide, slightly curved, compressed, sides flattened, with about eight or nine longitudinal ridges, which are smooth and less than their own diameter apart; the intervening spaces finely striated longitudinally; posterior concave face with two regular, close rows of small pointed teeth directed very obliquely downwards; the surface towards the base is marked with small, scattered, oval, smooth tubercles; anterior branch three times as long, and about the same size at its origin as the posterior spine; the part of the spine from which those two portions take their common origin is equal to the width of their united bases, and covered with scattered round tubercles; the height of the anterior branch is double its width at the basal half, but it becomes depressed, so that its width is double the height in the section of the distal half; it is covered above and on the sides with close quincuncially arranged, smooth, oval tubercles; the compressed, finely striated base which enters the flesh seems abruptly truncated below. Length of posterior spine 1 inch, width at base 6 lines; length of anterior process (imperfect at extremity) 2 inches 9 lines, depth at base 4 lines, at tip 1 line; width at base 2 lines, at tip 3 lines; length of the common base $1\frac{1}{2}$ inch, width 9 lines.

Not very uncommon in the carboniferous limestone of Armagh. (*Col.* University of Cambridge and Capt. Jones.)

Cosmacanthus carbonarius (M'Coy).

Sp. Char. Spine nearly straight, semicylindrical; section semi-lunate; sides and anterior face broadly rounded in one continuous curve; posterior sulcus very wide, rounded; about eight longitudinal rows of small oval tubercles on each side, the tubercles nearly touching in each row, and the rows less than their diameter apart; no posterior teeth, the posterior sulcus being bounded by the last lateral row of tubercles on each side. A fragment 1 inch 8 lines long and $2\frac{1}{2}$ lines wide at the narrow end, increases at the rate of nearly 2 lines in an inch.

This differs from the Devonian *C. Malcolmsoni* (Ag.) in its greater size and much more numerous rows of tubercles. Two imperfect specimens from the limestone of Armagh are in the collection of Capt. Jones at Dublin.

Platycanthus (M'Coy), n. g.

Gen. Char. Ray triangular, very wide, the length of the base nearly equalling the height of the spine, arched backwards, much compressed; sides flat; anterior face flat, the thickest part of the ray; surface pustulated; two rows of sharp conical teeth on the posterior face.

In their great compression and pustulated surface the rays of this genus resemble the *Oracanth*s, but they differ from them by their small size, arched form, and distinct posterior rows of teeth, which latter character also distinguishes them from the *Byssacanth*s of the old red sandstone, as well as the absence of ridges on the surface. I only know the genus in the mountain limestone.

Platycanthus isosceles (M'Coy).

Sp. Char. Length of the base and height of the spine each about 1 inch; anterior face 1 line wide in the middle and slightly convex; surface covered with numerous smooth, oval or rounded tubercles subquincuncially arranged, largest towards the anterior face, about twice their diameter apart; intervening surface marked with minute, longitudinal rough sulci; posterior teeth conical, smooth at the apex, longitudinally plicated at the base.

Rare in the carboniferous limestone of Armagh.
(Col. Capt. Jones, R.N., M.P.)

Nemacanthus priscus (M'Coy).

Sp. Char. Ray much elongated, slightly arched, compressed towards the anterior face, which forms a prominent rounded ridge or keel; sides with numerous unequal, irregularly placed, oval, blunt tubercles, between which the surface is marked with longitudinal rows of minute impressed puncta, and a few irregular impressed flexuous striæ; base attenuated and finely striated.

This spine agrees with the Triassic *Nemacanth*s in having the sides flattened and inclined towards the anterior face, on which is a central rounded ridge or keel. The only specimen I have seen is imperfect, measuring $3\frac{1}{2}$ inches in length; the broken distal extremity is 4 lines in antero-posterior diameter and 2 lines wide.

From the red limestone of Armagh.
(Col. of Capt. Jones.)

Dipriacanthus (M'Coy), n. g.

(Etym. *δῖς*, *bis*, *πρίων*, *serra*, and *ἀκανθα*, *aculeus*.)

Gen. Char. Spine small, arched, tapering, much compressed,

minutely and irregularly tuberculated; two rows of small conical teeth on the posterior margin, and two rows of larger adpressed teeth on the anterior face directed upwards.

The spines for which I propose this name are easily recognised by their small size, curved form, and having the anterior, as well as the posterior, margin armed with rows of teeth. These characters, while they separate them widely from the other fossil spines, strongly recall to our mind the *Pimelodes* and *Synodonts* of the Nile; in fact the *Synodontus serratus* described by Rüppell* is a perfect prototype, in its spinous defences, of our *Dipriacanthus falcatus*, except that both the anterior and posterior rows of teeth are single on the recent spines. In their compressed section and irregularly tuberculated surface the *Dipriacanthus* resemble the *Oracanthus*, but are distinguished by their arched figure and rows of teeth.

Dipriacanthus falcatus (M'Coy).

Sp. Char. Spine slender, gradually tapering, much hooked, compressed, sides convex; section oval, long diameter twice the length of the short diameter; surface with very minute irregular, longitudinal striæ, and few distant, irregularly scattered, small tubercles; teeth of the posterior margin short, conical, at right angles to the spine; teeth of the anterior margin slender, pointed, adpressed close to the spines with their points upwards. Length of specimen imperfect, at base 1 inch 2 lines, greatest width 2 lines.

The specimen described is from the carboniferous limestone of Armagh.

(Col. Capt. Jones, R.N.)

Dipriacanthus Stokesii (M'Coy).

Sp. Char. Slightly arched, much compressed, sides flat, anterior and posterior margins narrow, obtusely rounded; section oblong, the long diameter being from four to five times longer than the short; teeth of the posterior margin slender, conical, projecting at right angles to the spine; teeth of the anterior margin large, thick, smooth, the upper sharp edge widest, closely adpressed to the surface; surface closely covered with small, irregular, smooth granules, which under a strong lens are found to be radiatingly striated at their base, and with the intervening narrow spaces very minutely granulated.

When highly magnified the granulation of this spine resembles on a small scale the star-like style of ornament of the bony plates

* Beschreibung und Abbildung mehrere neuer Fische, im Nil entdeckt, Frankfort a. M. 1829, pl. 2. fig. 1.

of *Asterolepis* (Eich.). The base is imperfect but apparently dilated in a remarkable degree, and in its present state the lower portion seems bent at a considerable angle from the curve of the rest of the spine.

Collected from the carboniferous limestone of Armagh by the Rev. W. Stokes of Caius College, Cambridge, and by him presented to the University collection. I have associated his name with this interesting form as a slight memorial of the zeal with which he has collected those remains, and the liberality with which he has made them available for public instruction.

Leptacanthus junceus (M'Coy).

Sp. Char. Nearly straight, about $1\frac{1}{2}$ line wide; section semielliptical; sides nearly convex, meeting in front to form a sharp anterior edge, and converging behind to a narrow posterior sulcus, bordered on each side by a row of strong, conical, downward-curved teeth, little longer than wide, and about the width of their base apart; each side with about seven longitudinal, narrow, equal, thread-like ridges, twice their diameter apart, and having between each pair two or three obsolete longitudinal striæ.

Rare in the black beds at the top of the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

(CESTRACIONTES—Teeth.)

Psammodus canaliculatus (M'Coy).

Sp. Char. Tooth oblong, generally about twice as long as wide, the two long sides straight and parallel, one of the short sides or ends very convex, the other equally concave (for articulation); the crown of the tooth concave along the middle, the two long margins being prominent and rounded; there is generally a considerable hump-like elevation near the convex end; surface roughly wrinkled transversely, the ends generally more or less rudely plicated longitudinally.

This remarkable tooth is much allied to the *P. rugosus* (Ag.), but is strongly distinguished by its ends being formed for articulation, one convex and the other concave, instead of being straight as in that species; also by the strong longitudinal plication of the surface near the ends, and the peculiar, curved, swelling near the convex extremity. When the ends are wanting it is distinguished by its mesial concavity (the other being convex), and by the minute rugæ of the surface running across instead of in the direction of the length. When much worn the

surface becomes polished and porous as in the *P. porosus* (Ag.), and as we constantly see on the prominent parts of the *P. rugosus* (Ag.). Length generally about 2 inches.

Rare in the Armagh limestone.

(Col. of the University of Cambridge and of Capt. Jones, M.P.)

Helodus appendiculatus (M'Coy).

Sp. Char. Transversely trigonal, compressed, width of the base rather more than twice the greatest height of the tooth; crown divided into an obtusely trigonal, straight, central compressed cone, and one very small, accessory similarly-shaped one on each side, sharply defined by a distinct notch; surface smooth, highly polished, porous at the apex and posterior side of the edge of the principal cone; edge of the enamel-like surface at the base obtuse, forming a slightly arched line, concavity downwards: bony root large, simple, coarsely fibrous.

Three teeth *in situ*, one behind the other, present the following characters:—the anterior tooth is the smallest, most compressed, and perfectly erect; principal cone sharp, but its height scarcely exceeding one-third of its width; secondary cone on each side very small, not as deeply separated from the middle as in the others; entire surface highly polished with the exception of the apex, which is slightly punctured. The second tooth is the longest and thickest, slightly inclined backwards; height of the principal cone about half its width; apex obtuse, small accessory cone on each side, pointed and defined by a deep notch from the central one; anterior side flattened, smooth, polished; posterior side tumid, coarsely punctured, the punctures extending over the apex. Third tooth entirely procumbent, the apex of the cone being marginal and in contact with the long, coarsely fibrous, osseous base, which latter is truncate below, is as wide as the tooth, and equals the principal cone in length: the proportions of this tooth are nearly those of the middle one, but having no posterior side; anterior side smooth and polished, apex punctured.

Rare: from the carboniferous limestone of Armagh.

(Col. Capt. Jones, R.N.)

Helodus rudis (M'Coy).

Sp. Char. Irregularly oblong, subquadrate; sides steep, irregularly nodulose or undulato-plicate; crown irregularly gibbous, the highest point a little nearer one end than the other; surface polished, coarsely punctured. Length 7 lines, width $4\frac{1}{2}$ lines, height $2\frac{1}{2}$ lines.

The curiously irregular lump-like figure and quadrate base of

this species distinguish it easily from its congeners; the steep, striated margin is also peculiar. The puncturing of the surface rather coarser than that of the *H. turgidus* (Ag.). I have seen several specimens from the Armagh limestone.

(Col. Cambridge University.)

Chomatodus obliquus (M'Coy).

Sp. Char. Obliquely rhomboidal, transversely elongate; apex marginal, obtusely pointed; middle of the tooth obliquely tumid or convex; attenuated sides flattened or slightly concave; ends obtusely pointed or rounded; surface highly polished and perfectly smooth except at the apex, which is coarsely punctured; basal margin surrounded by a broad imbricating fold of ganoine*, increasing to three or four on the ends of some of the teeth.

This species differs from the *C. cinctus* (Ag.) in its obliquely rhomboidal flattened form and marginal apex, as well as having but one fold of ganoine at the middle of the basal margin. In some examples the ends are equal and the width three times the length, in others the ends are unequal, and the length two-thirds of the width, but in all the apex is marginal and the general form obliquely rhomboidal, the basal margin having a downward curve nearly opposite the apical projection of the anterior margin, and between the two extends the oblique mesial convexity. Length averaging 4 lines.

Rare, in the carboniferous limestone of Armagh.

(Col. Cambridge University and Capt. Jones, R.N. &c.)

Chomatodus denticulatus (M'Coy).

Sp. Char. Transversely oval, base about three times wider than long; middle elevated into a compressed, obtusely pointed cone, about equal in height to the short diameter (length) of base, from which a sharp, much compressed mesial ridge extends on each side to either end, its cutting edge being broken into numerous obtuse, compressed denticles decreasing in size towards the ends; the notches which separate the little cones on the edge give rise to obtuse sulci, defining them a short way down the sides; surface smooth; base surrounded with three

* I provisionally use this term (from γάμος, *splendour*) to designate that peculiar, dense, modification of *dentine* which forms the highly polished surface of most fish-teeth, and which is not unfrequently confounded with the true enamel of the teeth of the higher animals; the latter is however secreted by a distinct organ quite external to and independent of the dentine, while the false enamel which I propose to call *ganoine* is merely produced by the calcigerous tubes of the dentine becoming suddenly straighter, closer and more numerous as they approach the surface.

or four imbricating folds of ganoine, irregularly jagged at their edges.

This species is rather smaller, more elevated and more compressed than the *C. cinctus* (Ag.), from which it is further distinguished by the number of minor cones set on the mesial ridge.

Rare, in the red carboniferous limestone of Armagh.

(*Col.* University of Cambridge.)

Petalodus rhombus (M'Coy).

Sp. Char. Crown sharp, compressed; *anterior face* rather more than *three times wider than high*, *regularly rhombic*, the upper and lower margins almost symmetrical, the lateral portions of each being nearly straight or slightly concave, and meeting in the middle at an obtuse angle; the angles of the upper and lower margins nearly equal, that of the basal margin pointing down, of the cutting edge up; the cutting edge is obscurely undulato-dentate by short obsolete vertical furrows, and minutely crenulato-striated; the lower margin is prominent and surrounded by five or six small imbrications of pseudo-enamel or ganoine, those descend lower (as usual) on the posterior face, where also the mesial angulation is less; surface smooth with a few fine irregular longitudinal striæ; root moderately large. Height of the middle of the crown 6 lines, width about 1 inch 9 lines, depth of root about 7 lines.

This can only be confounded with the *P. acuminatus* (Ag.), from which it is fully distinguished by the great proportional width of the crown and the rhomboidal form of the anterior face produced by the similar shape of the superior and basal margins; the latter being deeply angulated in the middle, resembling the cutting margin reversed in the present species, while the middle half is very obtusely rounded in the former, and then abruptly curved upwards and again downwards further towards the ends; in that species also the cutting edge, although slightly waving, is destitute of the broad longitudinal plicæ of the present form.

Rare, in the carboniferous limestone of Derbyshire.

(*Col.* Cambridge University.)

Polyrhizodus (M'Coy), n. g.

Gen. Char. Tooth thick, crown but slightly elevated, forming a transversely oval crushing surface, narrowing towards the extremities; anterior and posterior ridges separating the crown from the root, obtuse, without imbricating folds, the posterior ridge much lower than the anterior; root very large, deeply divided into several distinct, root-like lobes or fangs.

This is perhaps the most remarkable genus of ichthyolites yet

made known, as it presents the only instance in the entire class of a fish-tooth divided into several distinct fangs—the imperfectly double, divaricating, base of certain sharks' teeth, or the prolonged external plicæ of certain sauroids (*Holoptychius*, *Rhizodus*, &c.) not deserving to be viewed in the light of really divided or fanged roots as in the mammals and the present genus of fish. The group is most allied to *Petalodus* (Owen), with which Agassiz seems to have unaccountably confounded one of the species; but instead of the thin, scale-like or petal-like character of the *Petalodi*, with their highly elevated, compressed, sharp-edged crown, we have here a tooth of remarkably thick and clumsy form, with the crown but little raised and all the parts obtuse; the crown in *Petalodus* is covered with a thick coat of smooth, highly polished enamel-like substance or ganoine, and separated on each side from the root by several imbricating folds, while the crown in the present genus is nearly as dull as the root, and in one species coarsely punctured as in *Psammodus*, and the characteristic basal imbrications are replaced by a simple, obtuse ridge; finally, in *Petalodus*, the root forms a large, simple, compressed truncated base, while in *Polyrhizodus* it is divided into from five to eight fangs.

Polyrhizodus magnus (M'Coy).

Syn. *Petalodus radicans* (Ag. MSS. name in collections).

Sp. Char. Tooth from one-half to two inches wide and about one inch in depth; crown from three to four lines wide, nearly flat, inclined at an angle of about 70° from the slightly raised posterior edge, smooth, or with minute branching striæ on the upper edge; anterior and upper margins nearly parallel for the middle half of the width, while they rapidly converge in the two outer fourths, so that the extremities are narrowed to a point at each end and considerably bent downwards; root very thick and deeply divided into six or eight long, ovate fang-like lobes, roughened by the passage of the nutrient vessels; inferior, posterior ridge is (like the anterior margin of the crown) simply rounded, without imbricating folds, and about one-third more than the width of the crown below the cutting edge.

This fine species is not uncommon in the limestone of Armagh. (*Col.* University of Cambridge, Capt. Jones, Mr. Griffith, &c.)

Polyrhizodus pusillus (M'Coy).

Sp. Char. Crown compressed, raised into a rounded obtuse lobe less than half the width of the base in height; base of the crown forming a very prominent obtusely rounded ridge; root divided into about ten small rounded fangs; surface of the

crown coarsely punctured, a few of the punctures near the apex longitudinally confluent so as to give it a slightly pectinated appearance; width of crown $2\frac{1}{2}$ lines.

Easily distinguished by its small size, coarsely punctured surface and the raised lobe of the margin of the crown.

Rare, in the limestone of Armagh, from whence there is one example in the University collection at Cambridge, and another in that of Capt. Jones.

Glossodus (M'Coy), n. g.

Gen. Char. Tooth tongue-shaped, oblong, quadrangular, much higher than wide; crown elevated, slightly recurved, narrowing from the base to a small, subtruncate apex; surface porous, puncta generally seeming confluent towards the apex; punctured surface terminating below in a notch, or arched line, the convexity upwards; root long, as wide as the crown, coarsely fibrous.

The *Glossodi* are distinguished from the *Helodi*, with which alone they have any affinity, by the quadrangular form of the horizontal section of the tooth, the sides being flattened as well as the anterior and posterior faces; also by the great height of the crown in proportion to its width. The long root-like base of the tooth, which resembles that of some *Petalodi* (e. g. *P. psittacinus*, Ag. MSS.), rather than that of *Helodus* in form, is of an open lacunose structure, being permeated by very large flexuous medullary canals producing irregular openings on the surface. The ridge separating the punctured surface from the base forms a sinus directed upwards, which is the reverse of what we find in *Petalodus*, approaching the ordinary sharks, and also conforming to what we see in *Helodus* and *Strophodus* when the separating line in those genera is not straight. As in *Petalodus*, the basal margin of the surface is much nearer the apex on the convex anterior side than on the concave posterior or internal face, the latter being generally about twice the length of the former. The characters above given as distinguishing those teeth from the *Helodi* also separate them from the genuine *Petalodi* of Owen, as also the want of the imbricating folds at the base.

Glossodus lingua-bovis (M'Coy).

Sp. Char. Height of the crown exceeding the width of the base, which is three times the width of the truncated apex; greatest antero-posterior diameter half the width of the base; surface dull, covered with coarse, wide, occasionally confluent puncta, the interstices crossed by minute, flexuous, oblique striæ.

This curious tooth resembles a neat's tongue in miniature;

the oblique striation crossing the ordinary punctuation of *Psammodontoid* teeth is a character I have not seen in any other tooth. Height of crown 6 lines, width of base 5 lines, depth of root 4 lines.

From the carboniferous limestone of Armagh.

(Col. Capt. Jones, R.N.)

Glossodus marginatus (M'Coy).

Sp. Char. Crown about one-third higher than wide, having a slight antero-posterior sigmoidal curve; thickness, from before backwards, little more than one-fourth of the width; lateral margins subparallel, prominent on the posterior face, which is gently concave in the middle; apex narrowed, rounded, curved backwards; surface glossy, finely punctured, marked towards the tip with minute anastomosing longitudinal wrinkles; a few obtuse plicæ. Length of crown 5 lines, width 3 lines.

Easily distinguished from the *G. marginatus* by its more finely punctured, glossy surface, rounded tip and prominent lateral margins.

One of the rarest fossils of the carboniferous limestone of Armagh.

(Col. University of Cambridge; I think I have seen another in that of Capt. Jones at Dublin.)

Climaxodus (M'Coy), n. g.

(Etym. κλίμαξ, a flight of steps, and ὀδὸν, a tooth.)

Gen. Char. Tooth longer than wide, gradually narrowing towards the front with nearly straight sides; anterior part of the crown crossed by broad, imbricating, transverse ridges at right angles to its length; surface minutely punctured.

The above generic name has reference to the remarkable step-like character of the ridges which cross the anterior part of the tooth at regular intervals. The broad posterior part of the tooth is without ridges and resembles a *Psammodus*. In the fact of being as it were small, ridged *Psammodi*, those teeth are allied to the genus *Pæcilodus*, but all the true *Pæcilodi* are inequilateral, mussel-shaped teeth, consequently placed in pairs in the mouth, and have the ridges oblique; the *Climaxodi*, on the contrary, are equilateral, and were therefore most probably mesial in position, and the ridging is transverse. I am aware of one species in the Armagh limestone and the following. I think it possible that the so-called *Pæcilodus parallelus* (Ag.) may ultimately be referred to this genus, as it differs from the true *Pæcilodi* in some at least of the above characters.

Climaxodus imbricatus (M'Coy).

The only specimen I have access to at present of this species is imperfect at each end, being 7 lines long, $5\frac{1}{2}$ lines wide at the broad end, and 3 lines wide at the narrow anterior end; the anterior portion of the crown is crossed by 7 transverse imbricating ridges in a space of 4 lines, the posterior ones are three-fourths of a line apart, and have a double curvature arising from a small backward wave in the middle, the anterior ones are closer and pass with a slight forward curve across the tooth; all the imbrications have a backward curve at their extremities, giving them the appearance of lapping round the crown, and all have their free edges directed backwards, so as to resemble a row of *Petalodi* or other shark's teeth soldered together in the position they usually occupy, one behind the other; the posterior half is without ridges, the whole crown is slightly convex at the sides and concave in the middle; the surface is dull and seen by the lens to be finely punctured.

Rare, in the dark impure limestone overlying the main carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Pæcilodus aliformis (M'Coy).

Sp. Char. Wing-shaped or contorto-subtrigonal, narrow before, broad and subtruncate behind; inner, straight margin thin, higher in the middle than at each end, the surface seeming concave from thence to the external oblique margin, which is abruptly deflected, much thickened, rounded, strongly arched downwards at each end, with a slight sigmoidal curve; this ridge is crossed by seven or eight large, obtusely rounded wrinkles, which become obsolete as they approach the thin inner margin; surface finely granuloso-punctate under the lens.

This species most resembles some of the wing-shaped forms of the *P. sublevis* (Ag.), but the whole tooth is more strongly contorted sigmoidally; the external oblique margin is more thickened, ridge-like and deflected, and above all the great size of the transverse waves or wrinkles easily distinguishes it. The length of a perfect specimen is 1 inch 3 lines, width of the broad posterior end 9 lines, depth of the middle of the external margin 4 lines, width of the transverse wrinkles rather more than $1\frac{1}{2}$ line.

Rare, from the black upper limestone of Derbyshire.

(Col. University of Cambridge.)

Pæcilodus foveolatus (M'Coy).

Sp. Char. Longitudinally clavate, depressed, nearly three times

longer than wide ; anterior end narrow subtruncate ; surface obliquely crossed by nine or ten thick, flat, imbricating ridges, varying from one line to half a line wide ; they run nearly straight, but each has got an abrupt angular bend about the middle, which makes the posterior half of each edge seem about half a line further out than the anterior half ; each imbrication has one, or rarely two rows of large equidistant puncta or small pits.

This differs from the *P. Jonesii* (Ag.) in its very narrow elongate form, more numerous flat imbricating ridges, the row of notch-like curves one in the edge of each, and the regular rows of great puncta. The specimen described is imperfect, but seems to have been about $1\frac{1}{4}$ inch long and 4 lines wide.

From the upper black beds of limestone in Derbyshire.
(Col. University of Cambridge.)

• *Chirodus* (M'Coy), n. g.

(Etym. $\chi\epsilon\iota\rho$, *manus*, and $\delta\delta\omicron\varsigma$, *dens*.)

Gen. Char. General form of *Ceratodus*, that is more or less fan-shaped, thick, flattened, with the anterior broad margin deeply divided into lobes ; but the inner, nearly straight margin has a small, recurved, thumb-like lobe projecting nearly at right angles from the middle of its length (preventing the mesial junction of the tritons of each side of the jaw) ; the inner marginal lobe is the longest ; surface minutely punctured.

The only specimen which has occurred to me of this genus presents only two lobes in the anterior margin, but as the outer edge is imperfect there *may* have been another lobe, but I think not more. I should have referred the tooth to the Permian genus *Ceratodus*, but that the inner margin (which in *Ceratodus* is straight to fit the similar edge of the tooth on the other side of the jaw) has got a small lobe projecting horizontally inwards from its middle, which would prevent such a union ; or if it be viewed as possibly the outer margin, we would have the equally singular characters not only of so great a disparity in size between two adjacent lobes, but the principal marginal lobes would *increase* in size from within outwards, which would be contrary to all analogy. Hence, independent of the geological importance of not extending unnecessarily the vertical range of a genus, we find it zoologically impossible to group together teeth so differently constructed that they could not be similarly arranged in the mouth. I have named the genus from the general resemblance to a hand, or still more to the foot of a *Chirotherium* in miniature.

Chirodus pes-ranae (M'Coy).

Sp. Char. Length 8 lines, narrow; anterior lobes narrow, prominent, rounded, arched, separated by deep concave furrows; the inner lobe about a line longer than the next outer one; at the base of the former, or about half the length of the whole tooth, there projects horizontally inwards from the inner margin a short, wide, slightly recurved, flattened lobe, about 1 line long; posterior part of the tooth flattened; surface finely punctured under the lens.

This little species is something the size and shape of the foot of our common frog, whence the specific name.

Rare, in the black shaly beds of the carboniferous limestone of Derbyshire.

(*Col.* University of Cambridge.)

Orodus porosus (M'Coy).

Sp. Char. Subcylindrical, transverse diameter (or length of base) six or seven times greater than the antero-posterior; anterior and posterior margins nearly parallel, the middle being scarcely wider than the ends, which are obtusely subtruncate; sides slightly tumid, converging to a narrow mesial ridge; one small obtuse mesial cone not exceeding the short diameter of the base in height, and forming an obtuse ridge to the base on each; on each side there are four or five smaller tubercles, the smallest towards the ends, only those nearest the centre send one or two small ridges down the anterior side, while the posterior is more regularly ridged; basal margin tuberculato-plicate; surface coarsely punctured, except on the prominent worn points which are smooth; transverse diameter usually about 9 lines, short diameter $1\frac{1}{2}$ line.

In one example there are three nearly equal and similar teeth close behind each other; the mesial ridge is a little nearer the posterior than the anterior margin, and most so in the most anterior teeth.

From the carboniferous limestone of Armagh.

(*Col.* Capt. Jones, R.N., M.P.)

Orodus compressus (M'Coy).

Sp. Char. Much compressed, crown elevated into a thin edge of equal height throughout, surmounted by a fine ridge and festooned by four or five sharp points on each side; the centre has a larger point, producing a globular swelling in the middle of each of the flattened sides, over which it sends a small flexuous ridge giving out short branches on each side, while the lateral points only send short simple ridges not half-way down

the sides; ends abruptly truncated; base surrounded by a sharply defined thickened border; surface smooth, highly polished; root nearly as deep as the crown is high, truncate below and at the ends; height of crown 1 line, width of base $3\frac{1}{2}$ lines.

This *Orodus* is extremely like a *Ctenoptychius* in general aspect, from the thin, compressed, rectilinear, nearly square form of crown and root, the prominent, defined ridge at the base of the former and its pectinated upper edge; this edge however instead of being sharp is surmounted by a little ridge, from which the small lateral ridges are given off as above-mentioned—characters which do not exist in *Ctenoptychius*.

Rare: from the same locality and in the same collection as the last.

Petrodus (M'Coy), n. g.

Gen. Char. Teeth conical, supported on a nearly circular osseous base, concave beneath; crown with a dense compact surface, height not exceeding the width, deeply furrowed with rough radiating ridges. *Microscopic structure*: vertical and horizontal sections nearly similar, showing the centre to be composed of exceedingly coarse irregular medullary fissures, irregularly branching and anastomosing as they approach the periphery, and sending out at right angles minute, flexuous, calcigerous tubes into the large, irregular clear interspace; the enamel-like surface forms a wide, dark-coloured band of fine, straight, parallel calcigerous tubes at the circumference of the magnified section.

The above generic name brings to mind not only the peculiarly rugged *crag-like* aspect of those teeth, but also their relation to the genera *Orodus* and *Acrodus* (Ag.), from both of which they are distinguished by a simply conic form, the base being nearly circular and not greatly lengthened in one direction as in those genera, as well as the dense stony character of the surface and great depth, coarseness and star-like disposition of the superficial vertical ridges. The base is slightly hollowed in the middle below, of a coarsely osseous texture, penetrated with numerous small vascular canals. It is interesting to observe that of all the fossil teeth yet made known, the microscopic structure of the *Petrodi* approaches nearest to the internal characters of the recent *Cestracion*.

Petrodus patelliformis (M'Coy).

Sp. Char. Conical, height one-half to two-thirds the width of the base, which is round or rarely subtrigonal; apex rudely pointed, becoming flat by wear; sides radiatingly ridged with about

thirteen or fourteen very strong, single or dichotomous ridges, the sides of which are usually cut by numerous deep oblique sulci; the ridges are highest at the base, where they terminate abruptly; osseous base a little wider than the crown. Diameter of base 3 to 4 lines.

This tooth presents considerable variation in the proportion of height to width of the base, and also in the number and relative thickness and complexity of the ridges; there is no variety however sufficiently striking to require particular notice or occasion any difficulty in the identification of the species.

It seems abundant in some parts of the Derbyshire limestone. (Col. Cambridge University.)

HYBODONTES.

Cladodus levis (M'Coy).

Sp. Char. Principal cone very thick, slightly oblique, its height equal to half the width of the root; secondary cones two on each side, very strong, the outer largest and divaricating, nearly half the length of the principal cone; all the cones obtusely rounded at the summit, very slightly tapering, and the height of each slightly exceeding the width of its own base; base of the crown and osseous root concave; surface of all the cones smooth, highly polished. Width of crown 9 lines, height of principal cone from the basal margin 5 lines.

This closely resembles the *C. marginatus* (Ag.) in size and form, but the cones taper less and the species is fully distinguished by its smooth surface, destitute of the coarse longitudinal plaits or striæ of that or the allied species.

Carboniferous limestone of Armagh.

(Col. University of Cambridge.)

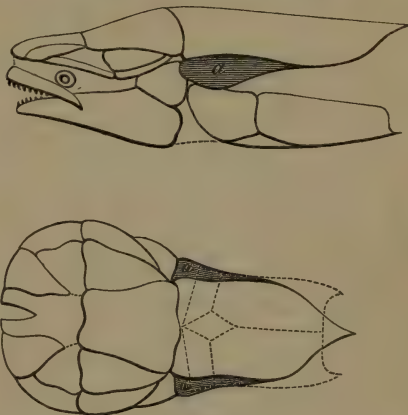
CHAPTER II.

FISH OF THE OLD RED SANDSTONE*.

PLACODERMI†.

Coccosteus (Ag.).

IN the *C. latus* (Ag.) I have observed a pair of lateral plates on the anterior part of the dorsal aspect of the carapace, which seem to have escaped the notice of M. Agassiz, and are omitted in his restored figures of the genus, although represented in the small figure given by Mr. H. Miller in his "Old Red Sandstone." Those plates are lengthened and triangular, the base in front parallel with the truncated anterior margin of the great dorsal plate, with which one of the long sides of each is articulated; the apex reaching to about half the length of the dorsal plate, terminating a little in front of the lateral angle on each side; the base being connected with the head and the outer margin with the anterior lateral ventral plate on each side. Those two peculiar plates might be called the "dorso-lateral plates."



Profile and dorsal aspect of the carapace of *Coccosteus* —the shaded plates *a* are the dorso-lateral plates.

I might also remark that the posterior latero-ventral plates, instead of joining precisely in the middle, overlap considerably,

* Drawings of all these species were sent to Prof. Phillips at the Meeting of the British Association at Swansea for the inspection of geologists. The descriptions date from the 'Annals of Natural History' for November 1848.

† The characters of this group were noted by the author in the 'Annals of Natural History' for July 1848.

that of the left side being in all the species larger externally than that of the right.

Coccosteus pusillus (M'Coy).

Sp. Char. Head and carapace orbicular, width about $2\frac{1}{2}$ inches, length 3 inches; tail about as long as the head and carapace, of very numerous small, weak (? slightly ossified) apophyses; dorsal fin small, weak; dorsal plate subpentagonal, 1 inch and 5 lines long, greatest width (at the lateral angles) 8 lines, tapering to a sharp point retrally, also narrowing about one-sixth towards the subtruncate anterior margin, all the margins concave, the anterior most so, middle of the plate obtusely keeled, the tuberosity and fossa (for lodging the dorsal spine?) rather more than one-third the length from the posterior apex; all the plates of the carapace minutely and regularly tuberculated, granules nearly equal, about their own diameter apart, fourteen in the space of a quarter of an inch, intervening spaces very minutely granulated; teeth slender, cylindrical, pointed, their own diameter apart, one-third of a line in diameter, nearly a line long.

The very small size and imperfect development of the vertebral apophyses, together with the small size and orbicular form of the cephalothorax, easily distinguish this species. The peculiar proportion of the dorsal plate, as well as the distance of its tuberosity and fossa from the apex, and the minuteness and regularity of the tuberculation, distinguish it from the young of the other species; besides, I find all the characters constant in five nearly perfect specimens which I have examined.

Not uncommon in the black flags of the old red sandstone at Orkney.

(Col. University of Cambridge.)

Coccosteus microspindylus (M'Coy).

This species resembles the *C. oblongus* (Ag.) in size and granulation, but has a much shorter dorsal plate, and the posterior external angles of the posterior ventral plates are produced into long curved processes as in the *C. latus* (Ag.), from which it differs in its strong, regular, close granulation; it differs besides from both species in the plates of the carapace being shorter, and most remarkably in the much smaller size and slight ossification of the vertebræ, giving a peculiarly weak and slender appearance to the tail. The bodies of the vertebræ have all left their separate impressions, so that the vertebral column was certainly not in this case a continuous cartilaginous cord as suggested by M. Agassiz in the case of the *C. latus*, in which they leave no trace. There is evidence of a thick spine, about an inch long, being attached to the tuberosity of the dorsal plate. The dorsal plate

is $2\frac{1}{2}$ inches long and $1\frac{1}{4}$ wide, with straight parallel sides, not being perceptibly narrower in front than at the lateral angles, in which it differs from the *C. pusillus* (M'Coy) as well as in size.

Rare in the black flags of Orkney.

(Col. University of Cambridge.)

Coccosteus? trigonaspis (M'Coy).

Sp. Char. Mesial ventral plate subtrigonal; slightly convex, 13 lines long and 7 lines wide at the lateral angles, which are only 2 lines behind the rounded or very obtusely angular anterior end; lateral posterior margins straight, converging to form the retral point; four or five irregular rows of tubercles, half a line in diameter, and less than their diameter apart, run round the margin, leaving a central, ovate, convex space more obscurely tuberculated; each tubercle consists of a hemispherical smooth centre (frequently perforated in the middle), surmounted by a thickened base which is radiatingly ridged, intervening space irregularly dotted.

This beautiful species is easily distinguished from all others by the shortness of the anterior end of its ventral mesial plate, which is the only part yet known. The tubercles resemble those of a small *Cidaris* or *Asterolepis*.

(Col. University of Cambridge.)

(*Acanthodidæ*.)

Chiracanthus pulverulentus (M'Coy).

Sp. Char. Elongate, fusiform, tapering very gradually from the pectorals, where the depth is little more than one-sixth of the length; tail moderate, lunately forked; the bony ray of the dorsal fin is slightly nearer the anal than the ventral fins, those latter being half-way between the pectorals and anal; the ventral spines are about half the depth of the body at their base, the others are about two-thirds of the depth; scales flat, rhomboidal, but the length and width nearly equal, apparently not imbricated, the posterior, inferior angle tumid, pointed; seven scales occupy a space of two lines; surface dull, covered with an exceedingly minute, crowded granulation (only visible under a strong lens). Length 8 inches.

The squamation of this species is so peculiar that a comparison with its congeners is rendered unnecessary; in general appearance it resembles the *C. Murchisoni* (Ag.). The head is imperfect, but seems rather pointed and about one-sixth of the entire length.

Rare in the old red flags of Orkney.

(Col. University of Cambridge.)

Chiracanthus grandispinus (M'Coy).

Sp. Char. Elongate, fusiform; tail slender, caudal fin large, moderately lobed; bony spines of the anal, ventral and pectoral fins of great size, their length being about three-fourths of the depth of the body at their base; the spine of the anal fin is gently curved backwards, those of the ventrals and pectorals straight; dorsal spine also of great thickness, but its length unknown, situated a little behind the line of the ventrals; scales rhomboidal, length and width nearly equal, about seven in the space of two lines, convex, strongly striated diagonally in the direction of the length of the fish, one of the diagonal grooves generally much deeper than the rest in the middle. Length from base of pectoral fin to extremity of tail nearly 8 inches, depth of body at base of dorsal fin 2 inches; pectoral and ventral spines nearly $1\frac{3}{4}$ inch long and $1\frac{1}{2}$ line wide at base, all apparently smooth.

In the great size and strength of its spines this resembles a great *Diplacanthus* rather than one of the comparatively feebly armed *Chiracanthus*; it however has got no second dorsal opposite the anal fin, and is clearly a peculiar species of the latter genus, from all the species of which the very large spines and strongly striated scales distinguish it. The branchiostegous rays are very numerous, slender and distinctly ossified; the cincture supporting the pectorals is very strong and bony.

Rare in bituminous flags of the old red at Orkney.

(Col. University of Cambridge.)

Chiracanthus lateralis (M'Coy).

Sp. Char. Slender, fusiform; dorsal nearly intermediate between the anal and ventral fins, slightly nearer the latter; spines of the ventral and anal fins very small, slightly curved, not more than half the depth of the body at their base, the dorsal spine about one-fifth longer than the others; sides of the body impressed by a strong, straight, lateral line, rather nearer the ventral than the dorsal margin; scales rhomboidal, a little higher than wide, smooth, each with a vertically diagonal, strong, angular mesial gibbosity, about six scales in the space of one line; length of anal spine 7 lines, depth of body at base of dorsal $1\frac{1}{4}$ inch.

I have only seen two tolerably good specimens of this species, which in size and general form both of body and spines resembles closely the *C. pulverulentus* (M'Coy), from which it is distinguished by its smaller and more pointed, vertically gibbous smooth scales, and having slightly smaller spines, and the ventral and anal spines being proportionally further apart, being

about equal to the depth of the body at the ventrals in the former, but exceeding it in the present species. What renders the *C. lateralis* most remarkably distinct from the other species of this and the allied genera, is the presence of a very strongly marked lateral line.

Rather rare in the old red sandstone flags of Orkney.

(Col. University of Cambridge.)

Diplacanthus gibbus (M'Coy).

Sp. Char. Very thick, fusiform, depth of the body behind the pectorals equal to the distance between the two dorsal spines; the dorsal spines are equal, about 1 inch long and 1 line wide, the first dorsal less than the depth of the body at its base; anal spine much shorter than the second dorsal; scales rhomboidal, length and width nearly equal, each with a large, vertically diagonal, oval gibbosity occupying nearly its entire area, about five scales in one line, surface seems very minutely granular. Length about $4\frac{1}{2}$ inches, greatest depth $1\frac{1}{2}$ inch.

This species has more equal-sided scales than the *D. striatus* (Ag.), and is nearly double the proportional depth; the spines are longer and more slender than in the *D. crassispinus* (Ag.), besides the difference in the scales.

Very rare in the old red flags of Orkney.

(Col. University of Cambridge.)

Diplacanthus perarmatus (M'Coy).

Sp. Char. Body thick, short, fusiform; tail very short, nearly square, its width only two-thirds the length of the second dorsal spine, the upper lobe projecting but little beyond the lower; spines smooth, extremely long, first dorsal equal in length to the space between the first and second dorsals, slightly less than the depth of the body at its base, gently curved; posterior spine straighter and about one-eighth longer than the anterior; pectoral spines half the length of the second dorsal; anal spine curved, only two-thirds the length of the second dorsal; ventral, medial and thoracic spines slightly curved and of moderate length; scales slightly higher than wide, nearly flat, minutely granulated (the impressions only seen), about three in the space of one line. Length from the base of the pectoral to the tip of the tail $4\frac{1}{2}$ inches.

This is most allied to the *D. longispinus* (Ag.), but has still longer spines, the second dorsal being especially remarkable; the dorsal spines are much longer in proportion to the distance between them and the depth of the body, the anal spine being on the other hand comparatively shorter; the tail is still smaller and more equal-lobed, and the scales much smaller and with the pro-

portion of length to width reversed ; I am doubtful about their surface, but the impressions seem distinctly though minutely and irregularly granulated.

Rare in the old red sandstone flags of Orkney.

(Col. University of Cambridge.)

Chirolepis velox (M'Coy).

Sp. Char. Very slender ; head slightly longer than the greatest depth of the body at the base of the pectorals, but less than one-fifth the entire length of the fish ; body tapering gradually from the head ; tail deeply forked, lobes narrow ; pectorals very large, broadly rounded, height two-thirds the depth of the body at their base ; ventrals nearly equalling the pectorals in length, and two-thirds their height ; there is only one-third of their length interval between those fins ; at the same distance behind the ventral is placed the large triangular anal ; it is larger than the dorsal, which is scarcely one-third of its length posterior to it ; both of those fins exceed in height the depth of the body at their base, and are more than their own length in advance of the caudal ; scales very convex, rhomboidal, diagonally sulcated, four in the space of one line. Length 9 inches. Fulcral scales of tail very slender, from 2 to 3 lines long and about $\frac{1}{3}$ rd of a line wide.

From its slender form, very large fins and forked tail, this would seem to have been one of the swiftest-swimming fishes of the Old Red period, and the above specific name will remind the ichthyologist of those characters. Its lengthened body and small head distinguish it from all of the genus except the *C. wagus* (Ag.), from which it differs in the great size of all the fins, their height in proportion to the depth of the body, the deeply forked tail, and the dorsal and anal fins being so far removed from the caudal. (Described from two beautifully perfect specimens.)

Old red bituminous flags of Orkney.

(Col. University of Cambridge.)

Chirolepis curtus (M'Coy).

Sp. Char. Short, fusiform, mouth very oblique ; head very large, nearly one-third the entire length of the fish ; body rapidly tapering from the head to the tail which is very small, and with a shallow concave posterior margin ; fins small, ventrals nearly three times longer than high, reaching to the anus, where the anal begins ; the anal is about twice the height of the ventral fins, and not quite so long, rather less than its own length in advance of the caudal ; the dorsal is slightly less in all directions than the anal, and is about one-third of its length behind it ; scales rhomboidal, four in the space of one line, each with a long, prominent, oval tubercle in the middle,

parallel with the posterior margin (some of those on the tail are diagonally sulcated in the direction of the length of the fish).

In the form and position of its fins this much resembles the *C. Cummingiæ* (Ag.), from which it differs in its larger head, more oblique mouth, smaller tail, and much shorter and more rapidly tapering body and tuberculated scales; by the latter character it approaches the *C. Traillii* (Ag.), from which it differs in the position of its fins, and equally with the *C. Cummingiæ* (Ag.) in the other characters mentioned above. Length $7\frac{1}{2}$ inches, greatest depth of body $1\frac{1}{2}$ inch. Fulcral scales broad, oval, 2 lines long and $\frac{5}{4}$ ths of a line wide.

Rare in the old red sandstone of Lethen Bar.

(Col. University of Cambridge.)

Chirolepis macrocephalus (M'Coy).

Sp. Char. Body thick, fusiform; tail short, abruptly narrowed from behind the anal fin to half the depth of the body at the pectorals; head very large, nearly one-third the entire length; teeth nearly equal, conical, pointed, width of the base two-thirds of the height, their bases nearly in contact; pectoral fins narrow, oval; ventrals nearly central, of moderate size, half their length distant from the anal, which is triangular, its height two-thirds its length, although less than half the depth of the body at its base; the dorsal is only two-thirds the length of the anal, but its height slightly exceeds its length; its anterior extremity is vertically over the middle of the anal fin, the posterior extremity extending slightly behind the extremity of the anal; caudal very large, deeply forked, but the upper lobe twice the length of the lower; fulcral scales very slender, about half an inch long and half a line wide, granulated; scales rhomboidal, four in the space of one line, gibbous, strongly sulcated diagonally except at the posterior angle. Total length 11 inches.

The great proportional size of the head distinguishes this from all its congeners except the *C. curtus* (M'Coy), from which it differs in the form and position of its fins, large tail, and diagonally sulcated scales.

Rare in the old red sandstone of Orkney.

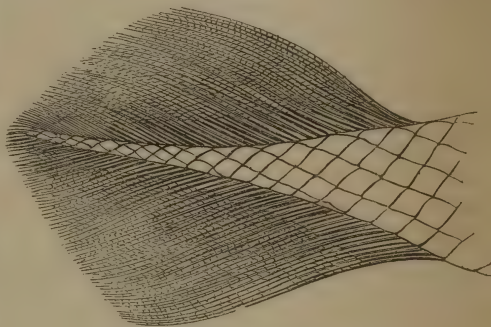
(Col. University of Cambridge.)

(*Saurodipteridæ*.)

Diplopterus (Ag.).

M. Agassiz has described the species of this genus as having heterocercal tails, and in his 'Monog. des Poissons Foss. du Vieux Grès Rouge' he gives a restored figure of the genus with

a heterocercal tail, the caudal fin large, obliquely subtruncate or slightly concave in the middle of the posterior margin, and confined to the lower side of the spine. I find, from the examination of probably more perfect specimens than were at the disposal of Prof. Agassiz, that the tail of this genus really presents a very different and peculiar structure; so far from being truly heterocercal*, there is almost as great a development of fin-rays above as below the spinal prolongation, the caudal fin having a rhomboidal form, the posterior margin pointed in the middle; the spinal prolongation is much attenuated, reaching nearly to the extremity of the fin; it is not precisely in the middle, but a little



Diphycercal tail (*Diplopterus*).

above it, as in the sketch. This form of tail I find in all the species of *Diplopterus* (Ag.), and also in *Gyroptychius* (M'Coy), and as it is in some measure intermediate in appearance between the "homocercal" and "heterocercal" types, though possessing some structural peculiarities of its own, I would propose to designate it in the descriptions by the term "diphycercal" (from *διφύης*, *duas habens naturas*, and *κέρκος*, *cauda*). In the "homocercal" or ordinary form of tail of most recent and the newer fossil fishes, we usually find a few of the last vertebræ anchylosed, and from the terminal mass so formed the greater portion of the caudal fin is developed, as much from the upper as from the lower aspect, and only the few short rays at the commencement of the fin being intercalated with the spinous processes of the preceding normally-formed vertebræ; in the "heterocercal" type the vertebræ do not coalesce into a terminal

* Some of the recent examples of heterocercal tails do not present the strongly-marked characters of the older fossil Ganoids; I allude particularly to the sharks, which when the skin is removed show a fringe of fin-rays *above* the spine, although much smaller than the great fins developed from the under side, thus making an approach to our fossil "diphycercal" type; this has been also noticed by Prof. Müller of Berlin, who hence remarks that the heterocercal and homocercal types pass into each other; in the fossils however the distinction is generally speaking a very marked and valuable one, and is scarcely affected by the discovery of the peculiar structure above illustrated, the notice of which will on the other hand remove some erroneous impressions.

mass, but diminish gradually in size to the last, forming a very slender prolongation of the body, inclining upwards, and the rays of the caudal fin being developed from the under side only, and being intercalated with the spinous processes of a great number of vertebræ; the "diphycercal" type agrees with the "homocercal" in the nearly mesial position of the termination of the body, and the nearly equal development of the caudal fin above and below; in those points it differs from the "heterocercal," while it agrees with the latter and differs from the former in the gradual attenuation of the spinal prolongation, the terminal vertebræ not being anchylosed into a vertically dilated mass, and the rays of the caudal being manifestly connected with the spinous processes of a large number of vertebræ. Those who think the theory of 'progressive development' worth refuting may be glad to find that some of the oldest-known *perfect remains* of fishes *have not exclusively heterocercal or "embryonic" types of tails as was hitherto supposed.*

Diplopterus gracilis (M'Coy).

Sp. Char. Very slender, depth about one-eighth of the length, nearly equal from head to tail; head narrow, subtrigonal, obtusely pointed, about one-fourth longer than wide; pectorals placed rather far back, small, narrow, ovate, about three-fourths the depth of the body, their base covered with scales as large as those of the tail, but more square; dorsal and anal fins nearly equal, opposite each other, their own length apart; they are triangular and pointed, their height exceeding their length; tail diphycercal, of moderate size; attenuated prolongation of the body nearly medial, the caudal fin itself being rhomboidal, pointed in the middle retrally; scales rhomboidal, those of the flanks about $2\frac{1}{2}$ lines high and $1\frac{1}{2}$ long, those of the tail smaller, more obliquely rhombic, but still with nearly equal sides; all appear under the lens minutely and closely punctured, the under side with a strong mesial articular ridge extending about two-thirds the length. Total length about 14 inches, head about one-seventh of the length.

Its small head and extremely narrow elongate form easily distinguish it from the other species.

Not uncommon in the old red flags of Orkney.

(*Col.* University of Cambridge.)

Osteolepis brevis (M'Coy).

Sp. Char. Very short, fusiform, length about 5 inches, body broadest at the anterior part, where the width is rather more than one-fourth the length, tapering abruptly to the tail, the pedicle of which is about one-third the depth of the body;

head very obtusely rounded, nearly semicircular, depressed, twice as wide as long, the length being only two-thirds the depth of the body; scales thick, nearly equilateral except on the flanks, where they are one-third higher than long, length of each about one line, surface minutely and uniformly punctured under the lens, the pores rather distant; two anal fins very small, ovate, their own length apart, the second touching the caudal; one large triangular dorsal fin, longer than high, opposite the space between the two anal fins (anterior dorsal not seen).

Easily distinguished from the other *Osteolepi* by its very wide, short figure, and from the great width of the head it is almost always found with the anterior part of the body crushed vertically. The teeth are very small, close and slender.

I have seen five specimens from the old red schists of Caithness and Orkney.

(Col. University of Cambridge.)

Tripterus (M'Coy), n. g.

Gen. Char. General shape of the body and form of the plates of the head and body as in *Osteolepis*, but having only one dorsal fin, which is precisely over the first anal fin.

The fishes of this genus are very much allied to *Osteolepis* in general habit, but instead of having two dorsal alternating with two anal fins, there is but one dorsal, which instead of alternating with or being vertically over the interval between the anal fins (as would be the case in *Osteolepis*, if only one fin was preserved), is *precisely over* the first anal as in *Diplopterus*, which it also greatly resembles, but from which it differs in wanting the second dorsal, and in having a perfectly heterocercal tail—a character which I have ascertained does not exist in *Diplopterus*.

Tripterus Pollexfeni (M'Coy).

Sp. Char. Ovate, gradually tapering from the head, which is broad, depressed, semi-elliptical, obtusely pointed in front, its width at base equal to its length, and being about one-fifth the entire length of the fish; pectoral fins small, broad, ovate, their height about two-thirds the width of the body at their base; tail small, perfectly heterocercal, retral margin very concave, and the upper lobe twice the length of the lower; two anal fins nearly equal, triangular, one-third higher than long, rather more than their own height apart, the second almost touching the caudal fin; dorsal fin narrow, ovate, almost twice as high as long, precisely over the first anal; scales rhomboidal, those of the body flat, about one-third higher than long, those of the tail longitudinally gibbous, lozenge-shaped, and about twice as long as high; under the lens they are all

very minutely and uniformly punctured as in *Osteolepis* and *Diplopterus*. Total length about 7 inches, greatest width of body $1\frac{1}{4}$ inch, length of body scales $1\frac{1}{2}$ line.

So completely identical are the plates of the head of this fish with those of the *large imperfect* example figured by Agassiz (Pois. Foss. vol. ii. pl. 2 *b*, fig. 2), that I cannot help suspecting that that figure may represent a portion of a fish of the present species, the imperfection of the retral part of the body having perhaps permitted M. Agassiz to refer it to the *Osteolepis macrolepidotus*, although even without seeing the fins we might distinguish it by its wide, rapidly tapering figure from that species, which is correctly represented by the fig. 1 of the same plate so far as it goes. The teeth are minute, slender, conical, rather distant, apparently in several rows, and of irregularly unequal size. I have examined three perfect specimens of this species presented to the University collection at Cambridge by the Rev. W. Pollexfen, by whom nearly all the Orkney fishes here noticed were collected, and whose zeal I am happy to commemorate by dedicating this to him.

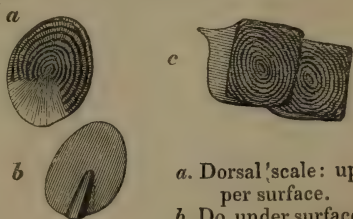
Not uncommon in the flags of the old red sandstone at Orkney. (Col. University of Cambridge.)

(CÆLACANTHI.)

Gyroptychius (M'Coy), n. g.

Gen. Char. Slender elongate ganoid fishes, with large semi-oval depressed heads, from which the body gradually tapers to the tail, which is diphyccercal, the caudal fin being rhomboidal, pointed in the middle of the retral margin, and the prolongation of the body extending a little above the medial line nearly to the end; two small elliptical dorsal fins exactly opposite two similar anal fins; pectoral fins broad, rounded, placed rather far back; scales subrhomboidal on the flanks, nearly oval on the back, imbricated, the exposed portion of each with minute rough ridges which converge towards the retral end, seeming to gyrate round a nearly central point; the anterior concealed portion nearly smooth (or under a strong lens minutely radiated as in *Holoptychius*); under surface of each scale nearly smooth, with a strong mesial keel which extends from the anteal edge

Scales of *Gyroptychius* $\times$ two diameters.



a. Dorsal scale: upper surface.
b. Do. under surface.
c. Lateral scales.

only as far as the central point, where it abruptly terminates to allow of the imbrication of the remainder of the scale on the next behind; bones of the head covered with granules which are sometimes confluent into short ridges; teeth small, conical, nearly equal.

In form, number and position of the fins and structure of the tail these fishes resemble *Diplopterus*, while the imbrication of the scales, as well as their sculptured, instead of simply porous surface, places them close to *Holoptychius*, and in a different family of Agassiz' system from the former; while from the latter they differ in form, number and position of the fins, structure of the tail, and in the ridge on the under side of the scales, which reminds us of what we see in *Osteolepis* and many other fishes with juxtaposed scales, but instead of extending entirely across the scale, it only reaches half-way, the half-ridge of one scale joining that of the next behind and before when in their natural imbricated position. The *Gyroptychii* are thus intermediate between *Holoptychius* and *Diplopterus*, and serve to connect the great groups of *Cœlacanth* and *Sauroid* fishes to which those genera respectively belong, having at the same time a style of sculpturing of the scales peculiar to themselves and easily recognizable. There are two imperfectly known and imperfectly characterized genera of M. Agassiz, *Glyptopomus* and *Platygnathus*, which require a few words in connexion with the present fishes. The first of those genera is founded on a short, thick, fusiform sauroid fish, with simply juxtaposed, rhomboidal, granulated scales; the fins being nearly unknown. The slender form, and the shape, sculpturing and imbrication of the scales are sufficient distinctions, the fins being unknown. *Platygnathus* is a genus founded by Agassiz on the jaw of one fish and the tail of another; the jaw agrees nearly with *Bothriolepis*, but has fewer laniary teeth and needs no comparison with *Gyroptychius*; the tail portion is more analogous, but the great scales seem to have simply the structure of *Holoptychius*, and the fins are developed beyond all comparison; further, this genus is founded on such imperfect and perhaps discordant materials, and the jaw seeming to have been most in view in naming and defining the genus, it is obvious that even an identity between one of those elements and the present perfectly known type would not invalidate *Gyroptychius* as a genus. Judging from the figure and description of M. Agassiz, however, there seems, as above noted, to be no great affinity between them.

Gyroptychius angustus (M'Coy).

Sp. Char. Head semi-oval, obtusely pointed, about one-sixth the entire length; depth of the body greatest immediately be-

hind the head, where it is one-seventh of the length, tapering very gradually from thence to the tail, the pedicle of which is about one-third the greatest depth of the body; caudal fin large, rhomboidal, obtusely pointed behind, lower side largest, the supramedial spinal prolongation extending nearly to the end; posterior anal fin semi-elliptical, equalling the depth of the body at its base in height, which is about double the length; both the posterior anal and dorsal fins nearly touch the caudal, and are fully their own height behind the anterior and dorsal fins, which are about one-third less in size; the pectoral fins are broad ovate, scarcely two-thirds the depth of the body at their base in height, and placed nearly their own height behind the head; scales about 2 lines high (or wide) and about one-third longer, elliptical and with a small, nearly central boss, round which seem to gyrate very numerous minute rough ridges, less than their own diameter apart, which are arranged in converging curved lines parallel with the margin of the elliptical free end of the scale; the small portion of the ridges anterior to the central boss are frequently broken into little tubercles; the more anterior concealed portion is smooth or very minutely radiated, the (? articular) ridge on the under side strongly marked; bones of the head closely sculptured with small granules and short vermicular ridges. Length nearly 1 foot; length of exposed portion of scales slightly more than 2 lines.

This beautiful fossil much resembles the *Diplopterus gracilis* (M'Coy) in form, but is at once distinguished by the structure and sculpturing of the scales.

Rare in the old red sandstone of Orkney.

(Col. University of Cambridge—two fine examples.)

Gyroptychius Diplopteroides (M'Coy).

Sp. Char. Head semi-elliptical, depressed, sides flattened, slightly longer than wide, pointed in front, about one-fifth of the entire length; body tapering rapidly from the head to the tail, the pedicle of which is less than half the width of the body; caudal fin rather large, rhomboidal, submedial spinal prolongation slender; posterior dorsal elliptical, twice as high as long, close to the base of the caudal, and reaching about half the length of its lateral angle; anterior dorsal little more than half the size of the posterior; pectorals short, broadly rounded, placed rather more than their own length behind the head; scales of the back oval, imbricated; concealed portion, anterior to the subcentral point, smooth or very minutely radiato-punctate, all the posterior or exposed portion rough with small, irregular, minutely flexuous ridges, those of each side running

parallel with the curved margin of the scale, and of course converging towards the middle, they are crossed by fine radiating striæ; scales of the sides rhomboidal, nearly square and juxtaposed, each scale articulated to the preceding and superior one by a narrow smooth border on the superior and anterior sides, extending into an angular articulating process at the anterior superior angle (as in *Osteolepis*, &c.); the quadrate exposed portion has a small central point, round which the little rough ridges gyrate diagonally; bones of the head sculptured with small vermicular ridges and granules.

Length about 11 inches, greatest width of body 2 inches; length of exposed portion of scales about 2 lines.

The different shape of the scales, and the wide, short, rapidly tapering figure easily distinguish this from the last.

Not uncommon in the old red schists of Orkney.

(Col. University of Cambridge.)

Holoptychius (Ag.).

Although so large a number of species of this genus are now published, I believe the form of the tail, and number and position of the vertical fins remain unknown. I have recently ascertained that the tail is short and perfectly heterocercal, and that one dorsal and one anal fin, nearly equal, but the dorsal largest, exist close to the caudal fin, and opposite each other; the ventrals are broad, placed behind the middle of the fish near the anal fin.

Holoptychius princeps (M'Coy).

Sp. Char. Scales subquadrate, slightly convex, each about 3 inches wide and $2\frac{1}{2}$ inches long; anterior concealed margin widest, convex; posterior, exposed portion about one-third narrower, subtruncate rounded, sides slightly concave; whole of the exposed surface closely covered with irregular tubercles about half a line in diameter and half their diameter apart; most of the tubercles are a little elongated, but in irregular directions, and towards the anterior margin a few of them are generally confluent at their bases, forming short, irregularly twisted, strongly tuberculated ridges; concealed anterior portion and interval between the tubercles minutely porous.

This species far exceeds the *H. nobilissimus* (Ag.) or *H. giganteus* (Ag.) in size; it is easily distinguished by its entirely tuberculated surface. A fragment of this species is well figured (without a name) in Murchison's 'Silurian System,' pl. 2 bis, fig. 3.

Old red conglomerate of Seat Craig.

(Col. University of Cambridge.)

Holoptychius Sedgwickii (M'Coy).

Sp. Char. Body fusiform, very thick, depth in the middle one-third of the length, abruptly narrowed towards the tail, the pedicle of which at the base of the anal and dorsal fins is scarcely half the depth of the body; head more than one-fourth of the length; tail very short, nearly square, the thick, articulated, frequently branched rays developed from the under side, forming a broad triangular caudal fin, obliquely truncated on its posterior margin; dorsal rather larger than the opposite anal fin, both semi-elliptical, twice as high as long; the anal about one-third the length of the base in advance of the caudal; ventral fins broad, their length about equalling their height, rather more than the length of their bases in advance of the anal fin; lateral line nearly medial, strongly marked: scales thin, rounded, those of the flanks half an inch in diameter, subtrigonal, posterior margin semicircular, concealed anterior margin very broad, subtruncate, with very minute radiating punctate striæ; immediately in front of this a small space towards the middle of the scale is covered with a distinct granulation (frequently but not always seen when the scales are *in situ*); all posterior to this, or the constantly exposed portion covered with a minute, longitudinal, irregularly flexuous, striate punctation, intermixed with numerous sharp, narrow, irregularly interrupted, longitudinal thread-like ridges, of very irregular number and length, but usually two or three times their diameter apart; the exposed part of the scales of the flanks, when *in situ*, is about one-third higher than long. Teeth conical, one-third longer than wide, half the diameter of their bases apart.

Length 11 inches, depth nearly 4 inches; length of teeth $\frac{3}{4}$ of a line.

This species, like the *H. Flemingii* (Ag.), is remarkable for being found on its side, indicating apparently a compressed, instead of a depressed form; it also resembles that species in the sculpturing of the scales, but has them (in the same parts of the body) smaller, more rounded, and the exposed portion much less high in proportion to their length.

Not uncommon in the old red sandstone flags of Orkney.

(Col. University of Cambridge.)

Conchodus (M'Coy), n. g.

Gen. Char. (Teeth in pairs in each jaw as in *Ceratodus* ?); each tooth large, somewhat semicircular, pointed in front, subtruncate behind, deeply concave on the grinding surface; internal margin straight, thickened, and with an abruptly

deflected edge; external border convex, much raised and strongly undulato-plicate, the ridges being largest in front, and gradually diminishing towards the external and posterior portion of the tooth; the plicæ are produced by a thickening of the substance of the ridges and a scooping-out of the intervening hollows, so that the under side of the tooth remains even; under surface coarsely osseous; upper surface polished, with small obscure undulations and minutely porous.

This genus is closely allied to *Ceratodus* and *Ctenodus*, but differs in the grinding surface being concave, the tooth resembling the inside of a plicated oyster. The internal microscopic structure was developed for me by the kindness and skilful manipulation of my friend Mr. Anthony of Caius College, Cambridge; it was very complex and peculiar, but the prepared fragment has unfortunately been mislaid, so that I am unable now fully to describe it. I only know one species, the following.

Conchodus ostreaformis (M'Coy).

About $1\frac{1}{2}$ inch long, 1 inch wide, and $1\frac{1}{2}$ line thick, the grinding surface deeply concave, the surface of attachment equally convex; the external semicircular margin gives origin to six or seven coarse, rugged, converging ridges, the most anterior about 7 lines long and slightly inclined to the straight inner margin, the most posterior is about 2 lines long and at right angles with the inner margin; the ridges are separated by deep, wide hollows.

Found along with *Dendrodus latus* (Ow.), *Holop. giganteus* (Ag.), and *Hol. princeps* (M'Coy), in the old red conglomerate of Scat Craig.

(Col. University of Cambridge.)

CHAPTER III.

MESOZOIC RADIATA*.

AMORPHOZOA.

Plocoscyphia laxa (M'Coy).

Sp. Char. Hemispherical masses about 2 or 3 inches in diameter, formed of short, wide, irregularly contorted and lobed cups, varying from half to 1 inch in diameter, the walls about 2 lines thick, of a rather coarse irregular spongy texture.

On comparison with the figure of Goldfuss, and with authentic specimens from the Essen chalk of his *Achilleum morchella*, which now forms the type of the genus *Plocoscyphia* of Reuss, I find the present species distinguished by its much larger, more deeply and widely separated cups, their much thicker walls, and very much more open lacunose structure. The contortion of the edges of the cups gives a superficial resemblance to some *Lobophyllia*.

Not uncommon in the greensand of Lyme Regis.
(Col. University of Cambridge.)

Jerea pastinaca (M'Coy).

Sp. Char. Very elongate-conic, subcylindrical, gradually tapering towards the base (the extreme apex sometimes abruptly narrowed), free end obtusely subtruncate with rounded margin, but not contracted in diameter; mouths of the vertical excretory tubes rather less than a line in diameter, chiefly confined to a circular area in the middle about half the diameter of the individual, leaving an external margin about one-fourth the diameter of a dense reticulated substance having a slightly radiated structure in the cross section and destitute of the large tubes. Average length 6 inches, diameter 2 inches, or larger.

This species resembles a carrot or parsnip in size and shape, whence the specific name; it is distinguished from the *Siphonia*

* The new species in this chapter date from the 'Annals of Nat. Hist.' for December 1848.

pistillum (Gold.) and *Jerea pistilliformis* (Lamx.), besides its peculiar form, by the vertical tubes being confined to the central part of the cylindrical mass, while in the terminal disc or transverse section of those species they are seen to open almost uniformly through every part; they are also much more numerous and rather smaller than in the present fossil.

Very common in the greensand of the Vale of Pewsey, Wilts.
(Col. University of Cambridge.)

Manon Reussii (M'Coy).

Sp. Char. A large, auriform, foliaceous expansion, averaging rather more than half an inch thick and from 3 to 5 inches in diameter; undulato-concave above and irregularly convex below; the pedicle of attachment small, excentric towards the side where the margins are inrolled; edge obtusely rounded, of a fine lacunose or spongy texture; upper and under surfaces with thickly scattered, prominent, wart-like mouths of excretory ducts a line in diameter, averaging twice their diameter apart on the upper surface, more crowded and irregular on the lower; intervening spaces of a more dense and uniform porous structure than the margins.

Besides the difference of form and size, this is distinguished from the *Spongia marginata* (Phil., Geol. of Yorkshire) and *M. Phillipsii* (Reuss, Versteinerungen der böhmischen Kreideformation) by having the large excretory pores on the outer as well as on the upper surface; the character is constant and strongly marked.

Common in the chalk of some parts of Yorkshire.

(Col. University of Cambridge.)

Manon foliaceum (M'Coy).

Sp. Char. A large, flat, or slightly concave, thin foliaceous expansion (averaging 7 or 8 inches in diameter and quarter of an inch thick) of a very dense, minutely porous structure; margin rounded; upper surface with numerous very prominent ostiolæ, averaging twice their diameter apart, rather less than a line in diameter, perpendicular to the surface near the base, but becoming obliquely elongated towards the margin like adpressed tubuli; under surface marked with concentric waves of growth without ostiolæ.

This singularly thin expanded species has no resemblance to any other I am acquainted with.

From the coralline oolite of Malton.

(Col. University of Cambridge.)

ZOOPHYTA.

(Zoantharia.)

Dentipora glomerata (M'Coy).

Sp. Char. Corallum forming irregular globose masses 2 or 3 inches in diameter, of a very dense granular structure, in which are distributed the circular cells, 1 line in diameter, and their own diameter apart; the stars have a small depressed centre, from which ten thick, equal lamellæ radiate to the circumference, where between each pair a minute rudimentary marginal lamella is usually seen.

Common in the coralline oolite of Malton.

(Col. University of Cambridge.)

Stylopora solida (M'Coy).

Sp. Char. Corallum forming spheroidal masses about 1 inch in diameter, on the surface of which circular cells open, 1 line in diameter with slightly prominent margins; a minute central style or axis from which six strong equal lamellæ radiate to the walls, where in some specimens a minute rudimentary marginal lamella may be seen between each pair; the cells vary from once to twice their diameter apart, the intervening substance very compact, with a minute obsolete superficial granulation.

The remoteness of the cells from each other separates this constantly from specimens I have examined of the *Astræa sexradiata* (Gold.) which agree with his figure in having them half their diameter apart, without perceptible variation, while from the *A. tumularis* (Michel.) it differs in its smaller and less prominent cells as well as form of the mass.

Not uncommon in the inferior oolites of Dundry.

(Col. University of Cambridge.)

Astræa (Lamk.).

From the unfavourable mode of petrification of the oolitic *Astrææ*, I am unable to seize their subgeneric characters with the precision I could wish—their specific characters are easy enough—I have therefore provisionally been obliged to leave them all under the old genus *Astræa* for the present, being unable satisfactorily to define their differences from the recent group.

Astræa tenuistriata (M'Coy).

Sp. Char. Corallum forming irregular flattened masses, of shallow polygonal cells, very unequal in size and shape (most

usual diameter about 5 lines); centre obscurely granular, radiating lamellæ very slender, close, minutely crenulated, alternately larger and several shorter (number varies with the size of the star, but always about twelve in a space of two lines at the margin).

In the very irregular size and shape of the stars and the great number and delicacy of the lamellæ, this agrees with the *A. confluens* (Gold.), from which it differs in the flatness of the cells, and in wanting the remarkable confluent character of that species, the young cells developing their boundary ridges almost on their first appearance.

Common in the inferior oolite of Dundry.

(Col. University of Cambridge.)

Astræa explanulata (M'Coy).

Sp. Char. Corallum forming flat expansions, of nearly equal, subrhomboidal, shallow cells, averaging 2 lines in diameter; radiating lamellæ from twenty-six to thirty, thick, very obscurely punctured or crenulated, about every third one reaching to the impressed central point; interstices very obtusely angular.

In the flat form of growth assumed by the masses, and in the equality, shallowness and tetragonal form of most of the cells, this strongly resembles the *A. explanata* (Gold.) of the Natheim oolite; but on comparison with authentic specimens of this latter, I find the cells of our species average only half the diameter of that, the radiating lamellæ are little more than half the number, are much thicker and almost perfectly smooth. In number and thickness of the lamellæ it more nearly approaches the common *A. helianthoides* (Gold.), but differs in their comparative smoothness and the more equal size and quadrate form of the cells, &c.

Common in the inferior oolite of Dundry and Bath.

(Col. University of Cambridge.)

Astræa helianthella (M'Coy).

Sp. Char. Corallum forming large depressed turbinate masses (generally from 2 to 5 inches in diameter and 9 lines to 2 inches high) with faint concentric wrinkles below, crossed by very minute radiating striæ; upper surface flat, covered with small, subequal, polygonal cells (diameter, or from centre to centre, varying from $1\frac{1}{2}$ to 2 lines) with rounded boundaries and very deeply excavated centres; lamellæ about thirty-eight, eight or nine of which reach the centre, of moderate, nearly equal thickness, slightly rugged.

This fine species is abundant in the lower oolite, and seems to be constantly distinguished from the *A. helianthoides* (Gold.) of the coralline oolite by its smaller and more equal cells, more numerous lamellæ and flatness of the masses, particularly of the stelliferous surface.

Common in the inferior oolite of Dundry.

(Col. University of Cambridge.)

Siderastræa agariciaformis (M'Coy).

Sp. Char. Corallum forming large foliaceous expansions; cells about $1\frac{1}{2}$ line in diameter, arranged in rows, the cells of each row half their diameter apart, the rows nearly twice their diameter apart; the cells are radiated by about twelve lamellæ from a depressed cellulose centre; they increase in number towards the margin, and the greater number take a straight course in two opposite directions to unite with the nearest star of the adjoining row on each side (giving the corallum the appearance of being strongly striated in one direction as in *Agaricia*).

This coral is very like the lower part (natural size) of Goldfuss's figure of his *Astræa flexuosa* from the cretaceous rocks of St. Peter's Mountain. It is most usual to find the *lower* side exposed by a sort of rough section, in which the cells project like the so-called genus *Montastræa*. In the section the small connecting vesicular plates are seen.

Common in the coral rag of Upware, near Cambridge.

(Col. University of Cambridge.)

Meandrina vermicularis (M'Coy).

Sp. Char. Corallum forming depressed rounded masses 3 or 4 inches in diameter; upper surface covered with vermicular contorted ridges about half a line in diameter, from 1 to 2 lines apart, and about 1 line high, variously connected at intervals, their sides very finely and regularly striated by the minute lamellæ (about eight or nine in the space of one line), and a single row of little stars in the valleys between each pair of ridges.

The extreme slenderness of the ridges and their strong contortion give this coral the appearance of a mass of little marine worms, and separate it easily from all known species; it far exceeds the *M. venustula* (Mich.) and *M. Lotharinga* (Mich.) in those respects, and I know no other species to which it makes any approach.

Rare in the inferior oolite of Leckhampton.

(Col. University of Cambridge.)

Montlivaultia (Lamx.).

I have satisfied myself, from the examination of a large suite of both foreign and British species, that the *Montlivaultia* of Lamouroux are identical in generic character with those corals to which Münster, Goldfuss, Esper, Blainville, &c. have restricted the name *Anthophyllum* of Schweigger, the different ages of the *A. decipiens* (Gold.) for instance demonstrating the identity of the groups in a single species. This renders the synonymy of the genus *Anthophyllum* more clear and definite than it has been. That genus was originally established by Schweigger in his 'Beobachtungen, &c. Anat. phys. Untersuchungen über Corallen' (tab. 6), and defined as agreeing with *Turbinolia*, except in being fixed and having the margin of the cells dilated; he divided it into five groups: the 1st, "*cylindri turbinati subsolitarii*," since formed into the genus *Cyathina* (Ehr.); 2nd, "*cylindri turbinati in ramos connexi*," being, from the species referred to, equivalent to the later genus *Cladocora* (Ehr.); 3rd, "*cylindri turbinati, e basi stirpis divergentes, versus basin concreti*," might I think be united to his 5th group, which is similarly defined except that the tubes are "*lamellis calcareis horizontalibus juncti*," a difference which disappears on examining specimens of the species he refers to as examples of the groups; the 4th group, founded on the *C. calycularis*, is referred by Ehrenberg to his *Caryophyllia*. It is unfortunate that the characters of this group as originally given are not applicable to any natural genus. Ehrenberg in his 'Beiträge zur Kenntniss der Corallenthiere des rothen Meeres' having formed the 1st group into one genus, the 2nd and 4th into another, has retained the name *Anthophyllum* for the remainder (*Caryophyllia fastigiata*, &c.), while, as above mentioned, nearly all the continental palæontologists have been in the habit of using it for the very different, turbinated corals which now occupy us, and which agree with the general definition of Schweigger, though probably not contemplated by him at the time. In the young state those corals are attached by a broad base, which soon becomes carious and hollow as the coral grows, undermining its base even to the thin external wall, which at last gives way, and the corallum thus becomes a free cone with a naked, obtusely rounded apex: some species grow so little vertically, that the separation from the carious hollow old base is effected in a nearly horizontal plane, so that the adult free corallum is scarcely distinguishable from *Cyclolites*, being circular, thin, flat, the upper and lower surfaces nearly parallel and both radiated: whether the form be flat or conical, the terminal star is never excavated into a cup, by which the species may be known from *Turbinolia* and *Cyathina*, as well as by the obtuseness of the margin (the

lamellæ extending over it), the thin easily lost outer wall, and the lamellæ being very thick and simply meeting in the centre without a cellulose axis.

Montlivaultia gregaria (M'Coy).

Sp. Char. Corallum forming turbinate masses (about 3 inches wide and nearly 2 inches high) of few individuals which terminate on the upper surface as prominent, disconnected, circular, slightly concave or convex discs with obtusely rounded margins, generally $1\frac{1}{2}$ inch in diameter, with about eighty thick radiating lamellæ, many of which reach the centre, the rest being irregularly smaller; connecting vesicular plates very delicate; external wall covering the lamellæ very thin, rarely preserved.

The individuals of which the turbinate masses are composed are identical in generic character with the ordinary *Montlivaultiæ*, as the term is here used; but no other species that I know has this gregarious mode of growth, nor will any other genus contain the species.

Common in the inferior oolite of Dundry and Cheltenham.
(*Col.* University of Cambridge.)

Dendrophyllia plicata (M'Coy).

Sp. Char. Corallum of approximately straight stems from $1\frac{1}{2}$ to 2 lines in diameter, giving off at an angle of about 60° branch-like cells averaging 3 lines long and slightly less in diameter than the stem, arranged spirally at short irregular distances; surface with fine longitudinal punctured striæ (about seven in the space of one line); for rather more than a line from the edge of each cell, every alternate superficial ridge becomes narrowed and depressed, the intervening ones suddenly acquiring a greater thickness and prominence, giving a plicated appearance to the ends of the branches; cellular axis and alternating lamellæ of the star as in the allied species of the genus.

This species most resembles the *Lithodendron* (*Dendrophyllia*) *granulosa* (Münst.) of the Abtenau tertiary beds, of which Goldfuss has given a tolerably good figure in his 'Petrefacten,' but the stem is smaller, not flexuous nor marked with annular constrictions; it is also much more finely striated, and is remarkable for the peculiar plication produced by the unequal projection of the alternate ridges towards the mouths of the cells.

Coralline oolite, Steeple Ashton.
(*Col.* University of Cambridge.)

Chrysaora similis (M'Coy).

Sp. Char. Corallum forming depressed rounded masses (usually about half an inch in diameter); upper convex surface with numerous small conical projections, generally rather less than a line apart, from which small, irregularly branching ridges radiate; the projecting points and ridges seem nearly solid and smooth, the intervening spaces coarsely punctured by the closely-placed openings of the minute cells.

This is so closely allied to the *Ceriopora* (*Chrysaora*) *venosa* (Gold.) of the Essen greensand that I scarcely can define their difference; the figures of Goldfuss of this latter species are both $2\frac{1}{2}$ diameters larger than nature, but making this allowance the character of the surface is nearly the same in both; the present oolitic coral seems however to be constantly smaller and more delicate in all its parts, and forms smaller and more depressed masses.

Great oolite. Not uncommon at Minchinhampton.
(Col. University of Cambridge.)

ECHINODERMATA.

*Crinoidea.**Bourgueticrinus cylindricus* (M'Coy).

Sp. Char. Column elliptical; body cylindrical, scarcely exceeding the stem in diameter, composed of four upper columnar joints of equal diameter, but the two upper thinner than the third, the fourth nearly double the thickness of the third, round in its upper half, abruptly compressed and elliptical in the lower half; on the upper columnar joint rest five pentagonal *pelvic plates* nearly equalling it in depth; between the upper lateral angles of these are five exceedingly small, pentagonal *first radial plates* not half the depth of the pelvic plates. Length of body to base of fourth columnar joint $9\frac{1}{2}$ lines, diameter $3\frac{1}{2}$ lines: articulating surface of columnar joints perfectly smooth, having a thickened external rim and a mesial transverse articular ridge perforated in the middle by a minute alimentary opening.

This is so strongly marked in all its characters that a comparison with other species is scarcely necessary: the "straight encrinite" of Parkinson (*B. æqualis*, D'Orb.) is easily distinguished by the above characters.

The nearest approach to it that I have seen is the so-called *Eugeniocrinites Hagenowii* (Gold.), figured by Dr. Hagenow in his memoir on the "Rügenschens Kreide-Versteinerungen" in Leonhard and Bronn's 'Jahrbuch' for 1840. The latter fossil,

though I think probably referable to the present genus, is distinguished as a species by the great depth of the two upper joints of the dilated column.

Rare in the upper chalk, Norwich.

(Col. University of Cambridge.)

Bourgueticrinus Milleri (M'Coy).

There are two species confounded in England under the name *Apiocrinus ellipticus* of Miller, by whom they are both figured without distinction; one with the first radial plates, about double the depth of the pelvic plate which most of his figures illustrate, is the one recognized by nearly all continental writers as this species, and as such is figured as the type of the present genus by D'Orbigny; to it therefore the name *B. ellipticus* should be retained. The other (fig. 1 of Miller's work) has the first radial and pelvic plates about equal in depth, with the same club-like figure; this, which is more rare, but constant in its characters, I beg to distinguish by the above name.

Upper chalk, Norwich.

(Col. University of Cambridge, &c.)

Bourgueticrinus oöliticus (M'Coy).

Sp. Char. Column much-compressed, of thin elliptical joints angulated and obscurely tuberculated round the middle of their outer edge; articular surface having a strong transverse ridge, with a central boss perforated by the small alimentary canal, external margin broad, central oval hollow, deep: long diameter 6 lines.

Among mesozoic crinoids the present genus is well characterized by its column, and as this is a large well-marked species, I have not hesitated to characterize it from the portion known on account of the interest attaching to its geological locality, the genus being hitherto only found in the upper chalk.

Rare in the Bradford clay at Bradford.

(Col. University of Cambridge.)

Apiocrinus exutus (M'Coy).

Sp. Char. Cup ovate (less ventricose in the middle than the *A. Parkinsoni*, Schlot., and more so than the *A. elegans*, Def.); about six of the upper columnar joints widen to form the base of the cup and increase greatly in thickness; on the upper columnar joint rest five pentagonal *pelvic plates*, alternating above which are five quadrangular *basal radial plates* (first costals of Miller), on each of which the cuneiform axillary ra-

dial joint (*scapula*) rests, the intermediate plate being wanting; on these rest two semiradial plates or *arms*; diameter at upper columnar joint 1 inch 6 lines; width of radial plates 9 lines, depth of each in middle 3 lines, depth of pelvic plates in the middle 4 lines, depth of upper columnar joint $4\frac{1}{2}$ lines; columnar articulation very finely radiated.

The comparative slenderness of its form and thickness of the upper columnar joints make it intermediate in those points between the *A. Parkinsoni* (Schlot.) and *A. elegans* (Def.), while it is distinguished from all of the genus by the want of the intermediary radial joints (or second costæ) in each row.

Rare in the Bradford clay, Bradford.

(Col. University of Cambridge.)

Pentacrinus dichotomus (M'Coy).

Sp. Char. *Column*, auxiliary side-arms, *pelvic* and *costal joints* as in the *P. Britannicus* (Schlot.), but the entire animal smaller and more slender, and the *auxiliary side-arms* proportionally wider; each of the five scapulæ supports two slender *arms* of nine or ten joints each, the last joint cuneiform, and supporting *two slender hands of equal thickness*, the inner usually of thirteen, and the outer of sixteen joints, each hand *regularly dichotomizing into a few very slender fingers of perfectly equal thickness*; auxiliary side-arms very thin, but equalling the arms in width. Length of body and fingers $1\frac{1}{2}$ to 2 inches.

This delicate little species has a very singular aspect, and differs from its congeners in the hands not continuing as thick main branches, giving off comparatively thin fingers from one side, but both hands and fingers dichotomizing into perfectly equal branches.

I have examined portions of eight heads, some nearly perfect, with their columns and side-arms, on a slab of lias shale from Whitby.

(Col. University of Cambridge.)

Pentacrinus Goldfussi (M'Coy).

Sp. Char. *Column* pentagonal, joints alternately thicker and thinner, or three thin between each pair of thicker joints, articulating by five oval, prominent, finely crenated ridges, the intervening spaces much depressed; *auxiliary side-arms* large, flattened, of elliptical joints, five arising from every thick columnar joint (one from each side), the long axis being attached vertically; pelvic joints large, cuneiform; *first costals* heptagonal, twice as wide as long, flattened (not produced into a

cone downwards), each having a prominent tubercle in the centre, adhering laterally by only a short portion of its margin; *second costals* horseshoe-shaped; *scapulae* cuneiform, as long as wide; from which two arms arise, of eight or nine joints, the last being cuneiform and supporting two hands, the inner of nine and the outer of fourteen or fifteen joints, the last cuneiform and giving off a lateral finger, and after fourteen or fifteen joints more another (total number of fingers unknown, but small).

In the great number, size, and mode of insertion of the auxiliary side-arms this agrees with the *P. Britannicus* (Schlot.), (*P. Briareus*, Mill.), but differs in its small size, broad oval pentapetalous markings of the columnar joints, and from that and all allied species it strongly differs in the first costals not being prolonged into a cone down the sides of the column.

There are clearly two species confounded by Goldfuss under the name *P. scalaris*, one of which, figured on the 60th plate of his 'Petrefacten,' is much allied to this; the other figures on pl. 52 of the same work differ considerably, but agree with numerous authentic specimens I have seen of that species from the German oolites, and also with some from our lower oolite at Dundry; the latter is therefore the most proper type of his species.

Marlstone, Gloucestershire.

(Col. University of Cambridge.)

(*Asteroïda**)

Goniaster (*Goniodiscus*) *rectilineus* (M'Coy).

Sp. Char. Sides straight or nearly so; on the dorsal surface each side has eight finely granulated, moderately convex marginal ossicles, of which the two end or "ocular" plates are triangular and the four intermediate ones are quadrate, *all of one length*, the width of each equal to half its length; the ossicles of the oral side are similar except the triangular plate at each end, which is there replaced by three smaller ones; plates of the disc small, polygonal and minutely granulated.

* Prof. Forbes having recently published in the 'Memoirs of the Geol. Survey of Great Britain' short descriptions of a number of new chalk starfishes, I trespassed on his good-nature so far as to send the notes and rough sketches of mine for identification. The one above described is distinct from any of his, but he suggests that the straightness of the sides may result from the suppression of one of them:—the specimen I first sketched may have been four-sided, for the two angles preserved are pretty nearly of 90°, but the second specimen has portions of its five sides preserved, and has all the above characters.

Width of each side 1 inch 3 lines; length of marginal ossicles 3 lines.

The straightness of the sides, and all the marginal ossicles (except the eye-plates) being of one size, so that the inner and outer boundaries of each row form two straight, parallel lines, distinguish this species, which is, I think, only likely to be confounded with the *G. regularis* (Park. sp.); I have good specimens of this latter now before me, and it is distinguished from the present species by having the margin of the sides *convex* outwardly, and the middle marginal plates being considerably the largest, the others decreasing rapidly in size towards the angles, so that the row of plates instead of being rectilinear and parallel-sided is clearly elliptical: this character is represented in Parkinson's figure, but not to the extent to which it is seen in nature, from the inner ends of the ossicles in his specimen being manifestly a little broken.

Upper chalk of Norwich (two specimens).
(Col. University of Cambridge.)

Asterias (Astropecten) recta (M'Coy).

Sp. Char. Rays five, straight, length from the base about three times the width of the disc, widest at the base, tapering gradually to the apex, with straight sides; rows of lateral plates averaging one-third the width of each ray (occupying rather less at the base and rather more at the apex); they average $1\frac{1}{2}$ line long and 3 lines wide, the long diameter or width diminishing gradually from the base to the apex; angles between the rays acute; disc and middle of the rays closely covered with blunt tubercles about $\frac{3}{4}$ ths of a line in diameter. Each ray about $5\frac{1}{2}$ inches long and 1 inch wide at base.

This species is distinguished from the *A. Aalensis* (Münst.) and the *A. arenicola* (Gold.) by the very long, rigid, straight-sided rays, there being no dilatation beyond the base as in those species, as well as its greater size, perfect specimens being upwards of a foot in diameter, while the others are little more than half that. The *Astropecten Orion* (Forb.) seems much allied, but is a smaller species with longer rays, the interradial angles obtuse, and the lateral plates square and much fewer in number. The starfish figured from the same locality as this in Charlesworth's 'London Geol. Journal,' no. 3. pl. 17, as the *A. arenicola* of Goldfuss, agrees with the present species in every particular save the dilatation of the rays beyond the base; this character exists clearly in the species of Goldfuss, which however is perfectly distinct by its shorter rays and other characters. I suspected that in the English fossil alluded to, this appearance might

have been a fault of the artist ; Forbes however has I presume seen the species, as he describes it (Mem. Geol. Survey, vol. ii. part 2. p. 477) in accordance with Charlesworth's figure, also referring it to Goldfuss's species, but without referring to the figure of that author, which is most accurate.

Not uncommon in the calcareous grit of Filey Brig, Yorkshire coast.

(Col. University of Cambridge : three specimens.)

(*Echinida*.)

Echinus petallatus (M'Coy).

Sp. Char. Conoidal (diameter $1\frac{1}{2}$ inch, height 1 inch 2 lines), base slightly contracted, obscurely ten-lobed ; ambulacral area half the width of the interambulacral, three oblique pairs of pores in each row ; the ambulacral and interambulacral spaces have each an elliptical, petal-like, concave, smooth space extending from the vertex nearly to the base, each space being one-third the width of its respective area ; the upper two-thirds of the ambulacral area have but one row of large tubercles on each side, surrounded by a circle of very minute granules ; towards the base where the smooth central space stops there are four rows of large tubercles ; the upper third of the interambulacral spaces has but two rows of large tubercles with their circle of small granules, but they gradually increase towards the base, and at the end of the smooth space there are about eight rows.

This is allied to the *E. gyratus* (Ag.), but is distinguished by having the elliptical smooth spaces in *both* the interambulacral and ambulacral areas ; the present is also a larger and more conical species.

Not very uncommon in the coralline oolite of Calne, Wiltshire.
(Col. University of Cambridge.)

Echinus diademata (M'Coy).

Sp. Char. Conoidal (diameter of one specimen 10 lines, height 6 lines), base abruptly flattened, subpentagonal from the prominence of the ambulacra, which are slightly convex and one-half the width of the interambulacra ; interambulacra having a concave, smooth, narrow space in the middle of their upper portion, the middle of each half bears one row of about twelve large primary tubercles, their wide smooth disc surrounded by a circle of minute granules, numerous granules being scattered in the intervening spaces ; only two or three very small secondary tubercles on the outside of the base of the primary rows ; ambulacra with two rows of large primary tubercles each,

with many small, irregularly placed intervening granules; three oblique pairs of pores in each row; ovarian and ocular plates as in the genus generally.

The two rows of large tubercles in each area, with the very minute intervening granules, distinguish this species from its congeners. It is most closely allied to the *E. fallax* and *E. serialis* (Ag.), but is well distinguished by the almost complete absence of secondary tubercles as well as the greater size of the primary ones, and the more pentagonal form of the disc, in which it approaches the *E. excavatus* (Gold.), from which it equally differs by the above characters.

Occurs in the coral rag of Malton and in the great oolite of Minchinhampton.

(Col. University of Cambridge.)

Arbacia inflata (M'Coy).

Sp. Char. Oblate-spheroidal (diameter 6 lines, height $4\frac{1}{2}$ lines), margin of the base tumid, rounded; ambulacra flat, depressed, slightly less than half the width of the interambulacra, the pores forming very narrow rows of one pair each, the space between the lines of pores with four to six very unequal, irregular rows of small granules; interambulacral spaces tumid, with a slightly impressed, narrow, smooth line down the middle of each; each interambulacral space contains about sixteen rows of minute tubercles, of which the two middle rows, or that bordering on each side the sutural line, are largest; under the lens the tubercles are distinctly arranged in transverse rows, eight on each interambulacral plate, touching each other without intervening granules, but between one plate and the next above or below (or between the rows) there are a few minute granules, generally arranged in one or at most two irregular rows.

Distinguished from the *A. pilos* (Ag.) by its more depressed, inflated form, rounded margin of the base, the outer* row of ambulacral tubercles not being largest, and the greater number of tubercles in both areas, as well as the central smooth line of the interambulacra; the *A. granulosa* (Münst. sp.) is much more depressed, has the ambulacra wider and more convex, the interambulacra more deeply divided, and a much greater number of tubercles in the transverse rows, which latter are separated by very numerous crowded granules.

Not uncommon in the upper greensand of Cambridge.

(Col. University of Cambridge.)

* By "outer" I here mean, adjoining the ambulacra, without intending to deny that the mesial line may be the true exterior.

Acrosalenia varispina (M'Coy).

Sp. Char. Spheroidal, depressed; ambulacra flat, slightly flexuous, with two rows of tubercles which towards the base are large, mammillated and perforated; interambulacra three times the width of the ambulacral spaces, primary tubercles very prominent, nearly twice their diameter apart, placed alternately, but scarcely more than two tubercles in each vertical row; each tubercle surrounded by a ring of blunt granules, and between one tubercle and another numerous similar granules are scattered.

I think the position of the anus and the plates of the vertex agree with that division of the genus to which the *A. aspera* belongs, but a little adhering siliceous matrix in each of the specimens before me prevents my being quite certain. The ambulacra being a little undulated also approximates it to the *A. aspera*, but it is a much rarer species, and easily distinguished by the singularly small number and great distance of the primary tubercles, and the quantity of intervening granulation. Diameter 4 lines, height $3\frac{1}{2}$ lines; sometimes larger.

Rare in the great oolite of Minchinhampton.

(Col. University of Cambridge.)

Hemicidaris confluens (M'Coy).

Sp. Char. Depressed (average diameter 9 lines, height 5 lines); ambulacra undulating, upper third narrow, gradually widening to the mouth; the upper portion bears very minute crowded tubercles, which gradually increase in the wide portion, forming two alternating rows of moderately large, perforated, crenulated primary tubercles with many intervening blunt granules; interambulacral spaces twice as wide as the ambulacral, with two rows of very large primary tubercles, only four to five in a row, the smooth bases of which are vertically confluent (not separated by rows of granules), two vertical rows of small granules between the tubercles.

The only species this can be confounded with is the *H. Thurmani* (Ag.), which it resembles in its depressed form and very few large tubercles, and in the small size of the tubercles on the interambulacral spaces, but in this species the ambulacra widen more and the primary tubercles on them are larger; while each of the primary interambulacral tubercles in that species is separated from the next above and below by several rows of granules, while they are confluent, so to speak, in the present.

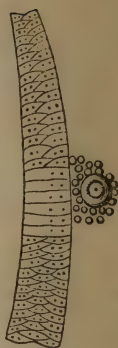
Rare in the great oolite of Minchinhampton.

(Col. University of Cambridge.)

Diplopodia (M'Coy), n. g.

Gen. Char. Depressed, subpentagonal from the projection of the ambulacral spaces; two rows of primary tubercles both on the ambulacral and interambulacral spaces; ambulacral rows of two pairs of pores in the upper half, of one pair in the middle and becoming again compound, of two or sometimes three pairs of pores towards the mouth.

This genus is distinguished from *Diadema*, to which it is most allied, and *Pedina*, by the former having uniformly one pair of pores in a row, and the latter having uniformly three pairs of pores in a row. The following species and the *D. subangulare* (Ag.) are the types of the genus, which is only known in the oolites.



Ambulacrum
of *Diplopodia*.

Diplopodia pentagona (M'Coy).

Sp. Char. Pentagonal, depressed, having an average diameter of 9 lines, with a height of 4 lines; interambulacral spaces one-third wider than the ambulacral at middle; two distinct rows of primary tubercles in each interambulacral space, surrounded by few small granules, and having on the outer side near the mouth five or six secondary tubercles one-third the size of the primary, forming a short single irregular row scarcely reaching the middle; ambulacral spaces with two rows of primary tubercles nearly equalling those of the interambulacra in size, having a few crowded granules between the rows but no secondary tubercles; there are only five or six pairs of ambulacral pores disposed in the single part of the row, rather below the middle, above which the pairs of pores are in regular double rows, each pair being separated by a diagonal line; below the single part of the ambulacra the pairs are in irregular double series increasing to three rows near the mouth.

This differs from the *Diadema* (*Diplopodia*) *subangulare* (Ag.) in its more depressed and distinctly pentagonal form, in the very short single portion of the ambulacra, there being nineteen or twenty pairs of pores in a single vertical row in the middle of that species, and in the deficiency of secondary tubercles along the margin of the interambulacra.

Not uncommon in the great oolite of Minchinhampton.
(*Col.* University of Cambridge.)

Discoidea marginalis (M'Coy).

Sp. Char. Nearly circular, depressed (length and width 1 inch,

height 6 lines), margin obtusely rounded; mouth one-third the diameter of the disc; anus small, pyriform, marginal extending as much above as below, its own width distant from the mouth; about six rows of primary granules in the ambulacral and fourteen in the interambulacral spaces.

The only other oolitic *Discoidea* I know with a marginal anus is the *D. hemisphærica* (Ag.), from which this differs in having the anus even more remote from the mouth, the mouth larger, the granules more numerous and smaller, and above all by the form being even more depressed than that of the *D. depressa* (Linn. sp.).

Very abundant in the inferior oolite of Bridport.

(Col. University of Cambridge.)

Pygaster sublævis (M'Coy).

Sp. Char. Orbicular, margin of the posterior interambulacral space more convex than the others; much depressed (length 2 inches 4 lines, width 2 inches 6 lines, depth 10 lines); vertex central; anal furrow deep parallel-sided, becoming gradually fainter towards the posterior margin; surface of oral disc undulated by the gentle convexity of the interambulacral spaces and the depression of the ambulacra; mouth only about one-seventh of the diameter, rather nearer the anterior than the posterior margin; granulation on the dorsal aspect so fine that the surface seems smooth or nearly so to the naked eye, abruptly increasing in size on the oral disc and margin, where however four of the primary tubercles only occupy the space of one line; in a transverse row there are nine or ten in an ambulacral and upwards of fifty in an interambulacral space.

In its depression, the shape of its anal sulcus, and the undulation of its base and small mouth, this species resembles a *Clypeus*, but the structure of its ambulacra, &c. is strictly that of this genus. Its nearly smooth surface, resulting from the very small size and prodigious number of the primary tubercles, distinguishes it from its congeners.

Common in the inferior oolite of Leckhampton.

(Col. University of Cambridge.)

Pygaster brevifrons (M'Coy).

Sp. Char. Subpentagonal, much elevated (length 3 inches 2 lines, width 3 inches 3 lines, height 1 inch 8 lines); posterior margin slightly less convex than the others; anus large, pyriform, close to the vertex, which is nearer to the anterior than to the posterior margin, so that in the profile the anterior side is con-

siderably shorter and more steeply inclined than the posterior; mouth small, deeply impressed; primary tubercles large, scattered.

This species in size and form of the base resembles the *P. umbrella* (Lamk. sp.) (*Clypeus semisulcatus*, Phil.), but is more elevated; and while in the profile of that species the *posterior* side is much the shortest and most highly inclined, the proportions of the present fossil are precisely reversed, a character which also separates it from the other known species. The tuberculation is as large, but more scattered than that of the *P. patelliformis* (Ag.).

Not uncommon in the inferior oolite of Dundry.

(Col. University of Cambridge.)

Dysaster symmetricus (M'Coy).

Sp. Char. Regularly oval (length 10 lines, width $8\frac{1}{2}$ lines, depth $6\frac{1}{2}$ lines), anterior and posterior ends equal in size and convexity, neither of them sinuate; uniformly gibbous, except a small subangular prominence at the apex of the anterior ambulacrum, and the middle of the base which is slightly concave, the margin of the base being obtusely rounded except in front of the mouth where it is concave—it is most tumid at the opposite end; mouth small, rather more than one-third of the length from the anterior end; anus high on the posterior face, the shell beneath is not sinuate, evenly convex; ambulacra of moderate and nearly equal width, the posterior pair meet just over the anus, the anterior one does not quite reach to the other two, the point of convergence of which is two-fifths the length of the shell distant from that of the posterior pair.

The symmetry of the two ends separates this species at a glance from its congeners.

Not uncommon in the inferior oolite of Bridport.

(Col. University of Cambridge.)

Dysaster subringens (M'Coy).

Sp. Char. Nearly orbicular, faintly subpentagonal by the projection of the interambulacra, depressed, but the height rather more than half the length (length 1 inch 1 line, width the same, height 7 lines); dorsal surface evenly convex; oral surface radiatingly undulated by the shallow concavity of the ambulacral spaces, and the gentle gibbosity of the interambulacra, the posterior one most prominent; each interambulacral plate seems on the oral face nodulous in its middle, forming two obsolete rows of nodules on each ridge; mouth nearly central; anus a little above the posterior margin; three anterior ambulacra meeting at the centre of dorsal surface, very

narrow, gradually enlarging towards the margin, posterior pair double the width of the anterior ones, short, curved, meeting immediately over the anus.

If carefully observed, this can only be confounded with the *D. ringens* (Ag.) of the Swiss oolites, but it is at once distinguished by its greater gibbosity (in which it exceeds the allied *D. Voltzii*) and in the less prominence of the ridges on the under side, which however exceed those of the latter species; the disproportionate narrowness of the three anterior ambulacra, as in the *D. ringens*, separates it from the *D. Voltzii* and *D. Eudesii* (Ag.).

Not uncommon in the inferior oolite of Dundry and Leckhampton.

(Col. University of Cambridge.)

Nucleolites planulatus (M'Coy).

Sp. Char. Rotundato-subquadrate, length and width equal, much-depressed, upper surface flattened, margin obtusely rounded (length and width 1 inch 3 lines, depth 6 lines); ambulacra wide, the pores of each pair in the petalloid part connected by a long distinct furrow; anal sulcus deep, extending from the vertex to the anal margin which it slightly indents; granulation very minute.

This species from its great depression need only be compared with the *N. planatus* (Römer, Versteinerungen des norddeutsch. Oolithengebirge), but it is wider than that species and the upper surface flatter, and I find on comparing specimens of the two species that the present is completely distinguished by its wide ambulacra and the very distinct sulcus connecting the pores of each pair; the ambulacra of the former species being narrow and the pores unconnected.

Common in the coralline oolite of Malton.

Rare in the great oolite of Minchinhampton.

(Col. University of Cambridge.)

Nucleolites pyramidalis (M'Coy).

Sp. Char. Base obtusely cordate or rotundato-quadrate, width equalling or slightly exceeding the length, much elevated to a nearly conical apex which is slightly nearer the anterior than the posterior end (length and width 1 inch 2 lines, height 8 lines); a deep narrow sulcus extends from the vertex to the posterior margin; petalloid ambulacra of moderate width, the pores of each pair united by a strong sulcus; upper surface not very tumid, but rather pyramidal, of four slightly flattened sides; profile, anterior end slightly convex, posterior face longer, forming a steeply inclined plane from the pointed vertex to the

rounded posterior margin ; granulation of surface very minute and close.

This resembles the *N. clunicularis* (Smith sp., *Clypeus lobatus*, Flem.) in the long, deep, narrow posterior sulcus, extending quite from the vertex ; but is wider and more quadrate, the base having exactly the form of the *N. scutatus* (Lamk.) ; from the latter it differs in the strong sulcus uniting the pores as in most of the genus, and from both species it is distinguished by its pointed elevated apex and the straight declivity of the posterior side.

Common in the cornbrash near Weymouth.

(Col. University of Cambridge.)

Nucleolites æqualis (M'Coy).

Sp. Char. Subquadrate, very much depressed (length 9 lines, width $8\frac{1}{2}$ lines, height 4 lines), evenly convex above, very concave beneath ; vertex central ; anal fissure deep, wide, and sharp-edged, extending from the vertex to the margin, which however is scarcely indented ; ambulacra very broad, petalloid part with the pores of each pair connected by a deep sulcus ; the two anterior interambulacral spaces are each at the margin only the width of an ambulacral space less than the width of the lateral interambulacral spaces.

This species is much depressed, but not flattened above ; the ambulacra equal or even slightly exceed those of the *N. latifrons* (Ag.) in width ; but the species is distinguished from all of the genus by the near equality in size of the interambulacral spaces, the two anterior ones, usually so small, being only the width of one of the ambulacra less than the lateral ones in width.

Great oolite near Minchinhampton.

Inferior oolite near Castle Ashby.

(Col. University of Cambridge.)

Clypeus excentricus (M'Coy).

Sp. Char. Orbicular, depressed (length and width each 3 inches 11 lines, height 1 inch 2 lines), posterior end slightly produced and sinuate ; anal sulcus deep ; vertex nearly one-fourth of the length nearer the posterior than the anterior end ; mouth small, a little excentric towards the anterior end ; ambulacra very wide ; granulation as in the *C. patella*.

This species differs from the *C. sinuatus* (Park.) by the vertex being so much nearer one end than the other, and from the *C. patella* by its much greater depression.

Abundant in the inferior oolite of Leckhampton.

(Col. University of Cambridge.)

Clypeus altus (M'Coy).

Sp. Char. Subhemispherical, base nearly circular, posterior interambulacral space slightly produced in the middle and subtruncate; length and width equal (each about 1 inch 9 lines), height half the width; upper surface evenly convex; oral disc strongly undulated towards the margin by the convexity of the interambulacral spaces and the depression of the ambulacra; vertex central, with a very narrow, deep anal sulcus extending from thence to the margin where it is slightly dilated and spoon-shaped; mouth small, a little in front of the middle, indented by the five tumid ends of the interambulacra; ambulacra narrow, upper two-thirds of their dorsal portion petalloid, lower third and oral portion of parallel rows of unconnected pores.

In form and undulation of the base this resembles the *C. Hugii* (Ag.), but is distinguished by the narrow anal sulcus extending quite to the vertex, instead of being confined to the margin; the deflected lip-like projection of the posterior interambulacral space is very remarkable.

Common in the inferior oolite of Bridport.

(Col. University of Cambridge.)

Exclusive of the above new species, I have, since the publication of Mr. Morris's Catalogue of British Fossils, recognised the following Mesozoic Radiata not included in it, examples of all of which are in the Geological Collection of the University of Cambridge.

AMORPHOZOA.

OCELLARIA.

- angustata* (Reuss sp.). *Scyphia* id., Verstein. böhm. Kr.
Chalk, Cambridge (drift).
pedunculata (Reuss sp.). *Scyphia* id., Verstein. böhm. Kr.
Chalk, Cambridge (drift).

SCYPHIA.

- Bronnii* (Münst.), Goldfuss, Petrefacten. Great Oolite, Minchinhampton.
cylindrica (Gold.), Petrefacten. Coralline Oolite, Malton.
heteromorpha (Reuss), Verstein. böhm. Kr. Greensand, Lyme Regis.

SPONGIA?

- helveloides* (Lamx.), Exp. Méth. Pol. Great Oolite, Minchinhampton.

ZOOPHYTA.

AGARICIA.

- elegans* (Michel.), Icon. Zooph. Inferior Oolite, Dundry.

ASTRÆA.

- confluens* (Gold.), Petrefacten. Great Oolite, Minchinhampton.
gracilis (Münst.), Goldfuss, Petrefacten. Great Oolite, Minchinhampton.
helianthoides (Gold.), Petrefacten. Coralline Oolite, Steeple Ashton.

ASTRÆA.

- limitata* (Lamx.), MSS. Michelin, Icon. Zooph. Inferior Oolite, Leckhampton.
reticulata (Gold.), Petrefacten. Great Oolite, Minchinhampton.
varians (Röm.), Verst. norddeut. Oolithen-Gebirges. Coralline Oolite, Malton; Upware.
 Great Oolite, Minchinhampton.

CERIOPORA.

- dumetosa* (Lamx. sp.). *Millepora* id., Exp. Méthod. Polyp. Great Oolite, Minchinhampton.
fibrosa * (Münst.), MS. name in his collection. Great Oolite, Minchinhampton.
globosa (Michel.), Iconog. Zooph. Inferior Oolite, Leckhampton.
grandipora (Münst.), MS. name in his continental collection. Great Oolite, Minchinhampton.
mutabilis (Münst.), MS. name in his continental collection. Great Oolite, Minchinhampton.
pustulosa (Michel.), Iconog. Zooph. Great Oolite, Minchinhampton.

CHÆTETES.

- capilliformis*? var. † (Michel.), Iconog. Zooph.

CRICOPORA.

- annulosa* (Michel.), Iconog. Zooph. { Great Oolite, Minchinhampton.
 Inferior Oolite, Leckhampton.
Tessonis (Michel.), Iconog. Zooph. Great Oolite, Minchinhampton.

DIASTOPORA.

- Eudesiana* (M.-Edw.), Ann. des Sc. Nat. 2nd series, vol. ix. Great Oolite, Minchinhampton.

GEMMASTRÆA.

- limbata* (Gold. sp.). *Astræa* id., Petrefacten. Great Oolite, Minchinhampton.

GONIOPORA.

- racemosa* (Michel. sp.). *Alveopora* id., Iconog. Zooph. Great Oolite, Minchinhampton.

HETEROPORA.

- ramosa* (Michel.), Iconog. Zooph. { Great Oolite, Minchinhampton.
 Inferior Oolite, Leckhampton.

LITHODENDRON.

- ? *astreatum* (Münst.), MS. name in his continental collection. Inferior Oolite, Dundry.
dichotomum (Gold.), Petrefacten. Coralline Oolite, Steeple Ashton.
Edwardsii (Michel.), var. Icon. Zooph. Coralline Oolite, Malton.

LOBOPHYLLIA.

- trichotoma* (Münst. sp.). *Lithodendron* id., Goldfuss, Petrefacten. Coralline Oolite, Steeple Ashton.

MONTLIVAUTIA.

- decipiens* (Gold. sp.). *Anthophyllum* id., Petrefacten. Oxford Clay, St. Ives; Inferior Oolite, Dundry.

* This is the oolitic, slender, nearly equal-pored variety of the *C. dichotoma* (Gold.), Petrefacten, tab. 10. fig. 9 *d, e, f*.

† A variety, perhaps, of this species occurs in the inferior oolite of Dundry, with coarser tubes, forming depressed masses, about an inch thick, with very distinct parallel lines of diaphragms at various distances—if distinct it might be named *C. Michelini*.

MONTLIVAUTIA.

- dilatata* (Michel. sp.). *Caryophyllia* id., Icon. Zooph.
Coralline Oolite, Malton.
Moreausiaca (Michel. sp.). *Caryophyllia* id., Icon. Zooph.
Coralline Oolite, Malton.
obconica (Münst. sp.). *Anthophyllum* id., Goldfuss, Petrefacten.
Coralline Oolite, Malton.

SIDERASTRÆA.

- cadomensis* (Michel. sp.). *Astræa* id., Iconog. Zooph.
Inferior Oolite, Leckhampton.
Defrancii (Michel. sp.). *Astræa* id., Iconog. Zooph.
Inferior Oolite, Dundry.
incrustedata (Michel. sp.). *Alveopora* id., Iconog. Zooph.
Great Oolite, Minchinhampton.
Lamourouxi (Le Sauvage sp.). *Thamasteria* id., Michelin, Icon. Zooph.
Great Oolite, Minchinhampton.
meandrinoides (Michel. sp.). *Pavonia* id., Iconog. Zooph.
Coralline Oolite, Steeple Ashton.
microsolena (Michel. sp.). *Alveopora* id., Iconog. Zooph.
Great Oolite, Minchinhampton.
rotata (Gold. sp.) var. *Agaricia* id., Petrefacten.
Coralline Oolite, Malton.

TEREBELLARIA.

- antilope* (Lamx.), Exp. Méth. Polyp. Coralline Oolite, Malton.

ECHINODERMATA.

ACROSALENIA.

- aspera* (Ag.), Cat. Syst. { Great Oolite, Minchinhampton.
Inferior Oolite, Dundry.
spinosa (Ag.), Echinoderm. Suiss. Great Oolite, Minchinhampton.

APIOCRINUS.

- elegans* (Defrance sp., *Astropoda* id.), D'Orbigny, Monog. des Crin.
Bradford Clay, Bradford.

CIDARIS.

- trigonocantha* (Ag.), Echinod. Suiss. Kimmeridge Clay, Weymouth.

DIADEMA.

- æquale* (Ag.), Echinod. Suiss. Coralline Oolite, Steeple Ashton.
ornatum (Gold. sp.). *Cidaris* id., Petref. Greensand, Blackdown.
Rhodani (Ag.), Echinod. Suiss. Greensand, Blackdown.
rotulare (Ag.), Echinod. Suiss. Durdle Door, Dorset.

DYSASTER.

- Avellana* (Ag.), Desor. Monog. des Dysaster.
Inferior Oolite, Bridport.
Eudesii (Ag.), Desor. Monog. des Dysaster.
Inferior Oolite, Dundry; Bridport.

DISCOIDEA.

- minima* * (Ag.), Desor. Mon. des Galer. Upper Greensand, Cambridge.
rotula (Ag.), Echinoderm. Suiss. Upper Chalk, Norwich.

GALERITES.

- castanea* (Brong. sp.), Ag. Echin. Suiss. Chalk, Cambridge.
lævis (Ag.), Desor. Monog. des Galerit. Chalk, Dover.
globulus (Desor.), Monog. des Galerit. Chalk, Cambridge.

* With the small anal plates preserved *in situ*.

HEMICIDARIS.

stramonium (Ag.), Echinoderm. Suiss. Coralline Oolite, Calne, Wilts.

HYBOCLYPUS.

gibberulus (Ag.), Echinoderm. Suiss. Inferior Oolite, Dundry.

MICRASTER.

gibba (Lamk. sp.). *Spatangus* id., Goldfuss, Petrefacten.
Chalk, Cambridge.

MILLERICRINUS.

echinatus (Schlot. sp.). *Encrinites* id., Nacht. z. Petref.
Coralline Oolite, Malton.

Milleri (Schlot. sp.). *Encrinites* id., Nacht. z. Petref.
Bradford Clay, Bradford.

NUCLEOLITES.

latiporus (Ag.), Echinoderm. Suiss. Great Oolite, Minchinhampton.
scutatus (Lamk.), Ag. Echinod. Suiss. Inferior Oolite, nr. Castle Ashby.

PEDINA.

rotata (Ag.), Echinod. Suiss. Great Oolite, Minchinhampton.

PENTACRINUS.

cingulatus (Münst.), Gold. Petrefacten. Bradford Clay, Bradford.
subteres (Münst.), Gold. Petrefacten. Bradford Clay, Bradford.
subsulcatus (Münst.), Gold. Petrefacten. Bradford Clay, Bradford.

PYGASTER.

umbrella (Ag.), Echinoderm. Suiss. Coralline Oolite, Malton.

TETRAGRAMMA.

Brongniarti (Ag.) var., Echinod. Suiss. Greensand, Blackdown.

CHAPTER IV.*

PALÆOZOIC CORALS AND FORAMINIFERA.

ZOOANTHARIA.

Petraia† *gigas* (M'Coy).

Sp. Char. Obtusely conical, slightly oblique, section elliptical; *internal cast* divided into forty broad, flat, smooth ribs, separated by the strong sulci of the principal lamellæ reaching to the centre; each of those ribs is divided by a fine mesial sulcus, the remains of the intermediate lamellæ, not reaching to the centre, making the total number of lamellæ about eighty. Length of imperfect cast 2 inches 7 lines; width of long axis at base 11 lines, at edge of cup 3 inches 7 lines (compressed), width of ribs 2 lines.

This large and strongly marked species from the number of its lamellæ can only be confounded with the *P. pluriradialis* (Phil. sp.) and *P. elongata* (Phil. sp.), from both of which it differs in its form and great size, width of ribs on the cast, absence of the punctures, &c. The strong primary lamellæ reach the centre with a very slight indication of twisting; the secondary ones are very delicate towards the base, but become nearly equal in strength to the others as they approach the edge of the cup. The denticulation of the lamellæ is scarcely perceptible.

Not uncommon in the fine gray Devonian slates of New Quay. (Col. University of Cambridge.)

* The descriptions in this chapter date from the 'Annals of Natural History' for January and February 1849.

† Having examined Count Münster's original specimens of several species of his genus *Petraia*, I have satisfied myself that they are really corals, as suggested by Mr. Lonsdale and others, although he describes them in his 'Beiträge' as Gasteropods, the publication of which view prevented Prof. Phillips adopting the genus in his work on the Fossils of Devon and Cornwall.

Clisiophyllum Keyserlingii (M'Coy).

Sp. Char. Conical, slightly curved, terminal cell oblique, 1 inch 2 lines in diameter in a specimen 3 inches long; surface finely striated longitudinally (about eight striæ in one-fourth of an inch); lamellæ thin, equal, about fifty-one, descending straight into the deep part of the terminal star, and then abruptly twisted spirally about an imaginary axis, forming a prominent conical centre about one-third the diameter of the cup, and as high as its base is wide.

This highly typical species of Mr. Dana's American genus *Clisiophyllum* is closely allied to the *Cyathophyllum coniseptum* of Count Keyserling's 'Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-Land,' from which it is distinguished by the strong twisting of the plates about the central cone, and by having little more than half the number of lamellæ at the same diameter. Viewing with Mr. Dana the conical arrangement of the septa as a generic instead of a specific character, it seems probable that the two varieties given by Count Keyserling of his *Cyath. coniseptum* are really two species; and the present species, though presenting some intermediate characters, is I think distinct; if hereafter any one should think otherwise, they still could hardly object to the name I have proposed in honour of so enterprising a geologist, the more so as the term *coniseptum* would not be applicable as a specific name in the genus *Clisiophyllum*, where all have the conical arrangement of septa alluded to; there can however, I think, be little doubt of the distinctness of the species. In the transverse section the central area seems a confused, close crumpling of vesicular plates occupying rather more than one-third the whole diameter, and from it to the circumference the strong, equal, rather distant plates radiate. The external vertical striæ are double the number of the actual radiating lamellæ.

Rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Clisiophyllum bipartitum (M'Coy).

Sp. Char. Very elongate-conic, nearly cylindrical, with a diameter of $1\frac{1}{4}$ inch for the greater part of its length; strongly and regularly striated externally (about five striæ in one-fourth of an inch); external striæ corresponding in number to the radiating lamellæ: in the *transverse rough section* the central area is rather less than one-third the whole diameter, composed of the edges of confusedly blended vesicular plates, crossed by a few faint extensions of the radiating lamellæ, and divided into two symmetrical portions by a strong median fissure; the

space between this inner area and the outer wall is regularly radiated with from sixty-three to sixty-nine equal, thin, rather distant lamellæ connected by numerous delicate, transverse, vesicular plates; *terminal cup* deep, lined by the vertical lamellæ, and having a large oval prominent boss in the centre traversed by a sharp mesial crest; about one-half or one-third of the radiating lamellæ ascend the central boss, always in a direct line, those at the sides of the mesial crest being at right angles to it, the others joining at a more acute angle as they approach the extremity, and opposite one end of the crest we generally observe one or two of the radiating lamellæ shorter than the rest, producing a sort of siphon-like irregularity such as we see in *Caninia*: *vertical section* indistinctly triareal; outer area defined, about one-sixth of the width on each side, composed of small, much-curved, vesicular plates, forming small semicircular cells arranged in very oblique rows upwards and outwards, about seven in a row; inner zone about equaling the outer one in width, passing gradually into the central structure, formed of slightly larger and less curved vesicular plates than the outer zone, and having a nearly horizontal direction; central area composed of large, thin, close, little-curved, vesicular plates, forming a strongly arched series of narrow, elongate cells, the convexity of the arch upwards, conforming to the shape of the central boss in the cup; if the vertical section be at right angles to the medial fissure or crest of the central boss, there is a line visible down the middle of the section.

This coral is interesting to the physiologist from the combination of the bipartite or symmetrical with the radiated type of structure, as in some *Fungia*, &c. It nearly equals the *Caninia gigantea* (Mich.) in size and cylindrical form, but is easily distinguished by the strong longitudinal striæ of the surface, the want of transverse septa in the central area, &c.

Rather common in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

Clisiophyllum prolapsum (M'Coy).

Sp. Char. Elongate-conic, much curved and twisted on its axis, *terminal cell* oblique, deep, with steep sides, a narrow flattened or concave space at bottom, from which protrudes the central boss, which is about one-third the diameter of the cup, nearly as high as wide, cylindrical, obtusely rounded above, and with a deep umbilical cavity in the middle (in partially decomposed or weathered specimens a rough vertical fracture frequently shows the central area as a thick, smooth, persistent tube);

diameter of the adult little more than an inch, and which it attains at two inches long, remaining nearly cylindrical after that length; *surface* closely striated longitudinally, about fifteen striæ in one-fourth of an inch, corresponding in number with the radiating lamellæ: *horizontal section*, inner area rather more than one-third the diameter, of small, closely blended, vesicular plates; outer area with 180 radiating lamellæ, ninety of which reach from the wall to the edge of the inner area, and ninety intermediate ones only reach half way; intermediate transverse vesicular plates very delicate: *vertical section*, inner area defined by rather thick walls; it consists of minute, compressed, elongate cells, arranged in transverse curved rows, the convexity of the curve upwards; outer area, large cellular structure, inclining upwards and outwards.

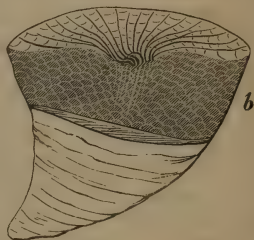
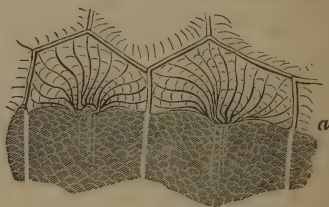
Rather common in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

Strephodes (M'Coy), n. g.

Etym. στρέφω, *torqueo* (from the twisting of the lamellæ about the centre).

(*Strombodes* pars of Lonsdale, not of Schweigger.)

Gen. Char. Corallum simple and conic, or compound and forming rounded masses of inseparably united polygonal cells; in either case the terminal cup is deep with numerous equal, radiating lamellæ, converging from the walls to the centre, where they meet and are complicated, usually twisted in bundles about an imaginary axis: *vertical section*, small vesicular structure, the rows of cells arranged in a semielliptical curve, convexity downwards, descending from the sides at a steep angle and rounding under the centre, where the cells are a little larger than at the sides: *horizontal*



Strephodes: a. vertical section and terminal cells of compound species; b. do, simple species.

section, radiating lamellæ meeting and complicated in the centre, connected by very thin transverse vesicular plates, and the stars of the compound species separated by thick divisional walls: *budding* in the compound species marginal, in the simple species often exhibiting periodical death and continuance of growth from the centre, giving an imbricating "ringed" appearance to the exterior.

This genus is most allied to *Cyathophyllum* and *Clisiophyllum*, all three having simply conic and compound polygonal-celled species. *Strephodes* differs from *Cyathophyllum* by the equality of the radiating lamellæ and their *meeting* in the centre both in the terminal cup and horizontal section, and in wanting the transverse diaphragms; from *Clisiophyllum*, which it resembles in the meeting of the lamellæ in the centre and the absence of horizontal diaphragms, it differs in the centre (though often slightly projecting) not being elevated into the large tent-like cone, characteristic of that genus, and in the rows of vesicular cells in the vertical section not having the reversed upward curvature which is connected with that peculiar form of cell. The simple species have been placed—I cannot imagine why—in the genus *Strombodes* of Schweigger by Mr. Lonsdale and some others (see the observations below on this latter genus). The compound species differ from *Astræa*, with which many palæontologists confound them, by the solid boundary-walls to the cells (see note on this genus below), and from *Acervularia* (Schweig., not Lonsd.) by the marginal budding and want of the central tube of that genus.

The genus *Streptoplasma* of Hall in his recent volume on the Palæontology of New York, although defined nearly in the same manner, and the name having the same meaning, applies obviously according to his specific descriptions and figures of all the species, not to the present corals, but to those known in Europe under the names *Petraia* and *Turbinolopsis*, in which the lamellæ extend directly and simply almost to the centre, only the most minute portion of the centre exhibiting in some species a trace of twisting, and there being none of the vesicular plates between the lamellæ which are so strongly developed in the present group.

Strephodes multilamellatum (M'Coy).

Sp. Char. Elongate-conic, very gradually tapering (generally about 5 inches long, with a diameter of about $1\frac{1}{2}$ inch at the termination); terminal cell oblique, oval, the short axis about one-third less than the long; surface regularly girt at about every quarter of an inch with slightly oblique, strong cup-

shaped rims of growth, concave above and produced by the successive growths from the centre leaving the prominent edges of the previous cells; weathered surface finely striated by the edges of the vertical lamellæ, of which there are about twelve in a quarter of an inch: the horizontal oval section shows the centre to be excentric, close to one of the broad sides, and formed by the twisting of the radiating lamellæ about an imaginary axis; radiating lamellæ very thin, of equal thickness, about 115 to 130 at the margin, some stopping and some uniting as they approach the centre, about which they are twisted in parcels; all the lamellæ connected throughout, at regular intervals, by minute transverse vesicular plates: internal structure exposed by horizontal and vertical sections, uniformly and minutely cellular.

The great number and closeness of the lamellæ distinguish this species from those published forms allied to it.

Rare in the lower carboniferous limestones of Arnside, Kendal, and Lisardrea, Boyle, co. Roscommon, Ireland.

(Col. University of Cambridge.)

Cyathaxonia costata (M'Coy).

Sp. Char. Elongate-conic, generally about one inch long and half an inch in diameter at the cup, which is circular and horizontal; surface irregularly wrinkled transversely, and marked longitudinally with remarkably thick, strong, sharply-defined striæ, about seven in one-fourth of an inch; central solid axis very thick (often one line in diameter), and from it twenty-six thick, wedge-like, vertical lamellæ radiate to the walls; transverse vesicular plates connecting the lamellæ exceedingly delicate; in the sections the vertical lamellæ are seen to dichotomise upwards, and the large curved plates of the loose vesicular structure incline upwards and inwards towards the axis.

This is more slender in form than the *C. mitratum* (Schlot. sp.) or *C. cornu-copiæ* (Mich.), and from which and all the other turbinated corals of the palæozoic rocks it is distinguished externally by the strong, distinct, distant longitudinal ridges; the internal characters approximate it only to the *Cyathaxonia cornu* (Mich.), from which it is distinguished by its simple, few and thick lamellæ and thick axis, as well as more turbinate form.

Rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Cyathophyllum dianthoides (M'Coy).

Sp. Char. Corallum very proliferous, forming wide conical groups; individual cones rapidly expanding, averaging one-third (or less) longer than wide, concentrically wrinkled and with obsolete longitudinal striæ externally; *terminal cup* very deep with either a sharp or truncated edge, and containing from 96 to 100 (as it approaches one inch in diameter) very thin, crenulated radiating lamellæ, alternately longer and shorter: *vertical section* shows less than one-third the diameter on each side occupied by minute vesicular tissue, the rows of cells extending obliquely upwards and outwards; the broad middle part is occupied by close, thick, transverse diaphragms. From eight to sixteen young cones take their origin from the inner part of the margin of favourably situated parent-cups, thus forming compound masses 3 inches or more in diameter, adult cones averaging $1\frac{1}{2}$ inch long.

This is closely allied to the *C. dianthus*, Gold. (*truncatus*, Linn.), and the compound examples of *C. turbinatum* (Linn. and Gold.), but is distinguished from the first by its wide, rapidly expanding cones, and from both by the lamellæ being distinctly of two alternating sizes, much thinner and greatly more numerous.

Common in the carboniferous limestone of Arnside, Kendal. (Col. University of Cambridge.)

Cyathophyllum paracida (M'Coy).

Sp. Char. Corallum of slender cones averaging half an inch wide at mouth and $1\frac{1}{2}$ inch long (generally somewhat smaller), straight or variously bent, and sometimes irregularly coalescing so as to form loose irregular masses; three or four young cones take their origin from within the margin of the parent cell, which they smother by their growth: *internal structure*, centre occupied by broad slightly undulated transverse diaphragms, four-fifths the width of the tubes; narrow outer area occupied by thirty-two equal, narrow, radiating lamellæ, variously connected by small, curved, vesicular plates; outer surface faintly striated longitudinally.

Allied to the *C. cæspitosum* and *C. quadrigeminum* of the older rocks, but the branches are not so long and cylindrical as in the first, nor so short or laterally united as in the latter; the number of the lamellæ and character of the narrow lamelliferous zone, and the very wide, distinct transverse diaphragms will serve to discriminate even fragments of the species.

Not uncommon in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

Cyathophyllum pseudo-vermiculare (M'Coy).

Sp. Char. Elongate, cylindrical, flexuous; surface very irregular, annulated or transversely nodular, coarsely striated longitudinally (about six striæ in one-fourth of an inch); branches averaging from half to three-fourths of an inch in diameter; small cylindrical branches project at distant irregular intervals from the sides: *internal structure*, central area rather more than half the diameter of the tube, defined, composed of flat, slightly undulated transverse septa, bearing at their circumference a series of from twenty-four to twenty-seven very short, rather distant radiating lamellæ, not reaching half-way to the centre; interval between this inner area and the walls filled with loose cellular structure, formed of small vesicular curved plates, highly inclined upwards and outwards.

This interesting coral perfectly resembles the *Cyathophyllum vermiculare* of Goldfuss in external characters, but by cutting and grinding down some specimens of the true Eifel coral of that species, I have ascertained beyond doubt (what was before suspected by Mr. Lonsdale) that it is not a true *Cyathophyllum*, but belongs to that group which I have named *Strephodes*, having the radiating lamellæ extending from the walls to the centre, and there twisted together without transverse diaphragms; it also has the curious character of the radiating lamellæ having an elliptical section, being thicker in the middle than at either end, a peculiarity which I have also noticed in a British (Devonian) specimen of the same species, though not alluded to by Mr. Lonsdale in his note on this species in the memoir of Prof. Sedgwick and Sir R. Murchison on the Devonian System. The present mountain limestone coral I have shown above to possess the true *Cyathophyllum* structure, and it is not therefore likely, after what I have stated with regard to the Devonian species, to be in future confounded with it. Externally it also bears a strong resemblance to the mountain limestone fossil which I have called *Lonsdaleia duplicata* (Mart. sp.), but that coral I have ascertained to possess the very different internal structure of *Lithostrotion* of Lonsdale (*Strombodes* of Schweigger), and it is consequently with a little care incapable of being confounded with the present fossil.

Not uncommon in the lower carboniferous limestone of Kendal; a variety also occurs in the lower carboniferous limestone of Kiltullagh, Roscommon, Ireland.

(Col. University of Cambridge.)

Diphyphyllum lateseptatum (M'Coy).

Sp. Char. Stems upwards of 8 inches long, cylindrical, about 3 lines in diameter; nearly smooth, very faintly striated lon-

gitudinally, and obsoletely wrinkled concentrically: *vertical section*, middle area occupied by slightly irregular transverse diaphragms extending across two-thirds the diameter of the tubes, about four in the vertical space of one line, their edges abruptly bent downwards; lateral areas very narrow, of equal width, the inner composed of one set of minute horizontal plates, the outer of two rows of minute, curved, vesicular plates inclining upwards and outwards.

This species differs from the *D. concinnum* (Lonsd.) of the carboniferous limestone east of the Ural chain, in the great proportional width of the transverse medial plates, which average two-thirds the diameter of the stem, or three times the width of the two outer areas of one side in the present species, but average one-third the diameter of the stem, or about equal to the two outer areas of one side in the other. The dichotomous mode of division of the stems characteristic of this group, and also the conical upward projections of the centre of the transverse lamellæ immediately under the point of fissure, were very well shown in many of the specimens.

Abundant in the carboniferous limestone near Corwen.
(Col. University of Cambridge.)

Stylastræa irregularis (M'Coy).

Sp. Char. Corallum of polygonal (five- or six-angled) tubes two lines in diameter, of such twisted and irregular upward growth that a vertical fracture frequently exposes a mixed appearance of outer walls and internal section; outer surface longitudinally striated and transversely wrinkled by waves of growth: *vertical section*, inner area broad, regularly septate by nearly straight, equal, thick transverse plates; outer area very narrow, composed of much-curved vesicular plates, forming rather open rounded cells, in rows obliquely upwards and outwards, two or three in a row: *horizontal section*, central area smooth, surrounded by about thirty slightly flexuous radiating lamellæ from the walls, fifteen of which are much shorter than the others; near the walls the radiating lamellæ are connected by few, thick, vesicular plates.

This species is remarkable for the peculiar, irregularly twisted mode of growth of the columns, which, when the rock is compact, gives the mixed character to the fracture seemingly between that of *Lithostrotion* (*Strombodes*) and *Stylastræa*. It is also remarkable for the nearly perfect transverse chambering of the central area. The small diameter of the tubes and few lamellæ easily distinguish it from the other allied species.

Forms small masses in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Strombodes.

Strombodes (Schweigger, not of Lonsdale) = *Lithostrotion* (Lonsd.).

This genus is defined by Prof. Schweigger (*Beobachtungen auf Naturhistorischen Reisen, &c. tab. 6*) as "*Cellulæ lamellosæ, centro depresso. Stirps e conis lamellosis in strata horizontalia conjunctis. Cellula terminalis cyathiformis.*" And he makes two divisions: 1st, "*coni e centro proliferi,*" for which he refers to the 'Amœnitates Academicæ' of Linnæus, vol. i. pl. at p. 312, figs. 11 and 4 (this figure however shows the origin of a *marginal bud* at one point). His 2nd group, "*coni e disco proliferi,*" and the reference to the same plate, figs. 10 and 3, belong to a true *Cyathophyllum* (*C. dianthus*, Gold.); his 1st group and the reference to the figures and description in the 'Amœnitates Academicæ' must therefore be taken as the type of the genus, and seem fully to justify the reference by Goldfuss of his American *Strombodes pentagonum* to this genus, the more so when the reference in Foug't's description, above referred to, to fig. 18 of the above plate, is taken into account. A coral perfectly similar to that of Goldfuss has been also figured by Mr. Dana in 'Silliman's Journal,' vol. iii. N.S., as an example of *Strombodes*. As therefore the notion that those compound polygonal-celled corals are the true *Strombodes* of Schweigger seems to prevail extensively, and I think justly, it only remains for me to add, that having carefully examined authentic specimens of the *S. pentagonum*, I find the cone-in-cone appearance of some of the figures to be produced by a peculiarity of weathering by which many of the vesicular plates towards the circumference of the stars have fallen out, and that the coral truly possesses all the characters so admirably elucidated by Mr. Lonsdale in the 'Geology of Russia' under the title of *Lithostrotion*, a name which it would be well now to replace by the old title *Strombodes* of Schweigger. In no case could either the definition or references of Schweigger justify the placing those Silurian and Devonian corals called *Strombodes* by Mr. Lonsdale in this genus. The following species is generically placed in accordance with this view.

Strombodes conaxis (M'Coy).

Sp. Char. Columns irregularly aggregated, averaging half an inch in width, mostly hexagonal: *axis* elliptical, formed of a series

of closely superposed conical plates, connected by a few fine vertical lamellæ: *lamelliferous zone* surrounding the axis narrow, of about forty-two alternately broad and rudimentary lamellæ, the interstitial plates of which are nearly horizontal: *outer zone* wide, formed of large arched plates, not highly inclined, and forming a loosely vesicular structure: *terminal star*, axis very prominent, oval, vertically ribbed, but not twisted, seated in a deep oval or circular cup, lined by the strong radiating lamellæ; outer zone nearly flat, oblique at the sides, faintly marked with rather distant, fine lines, representing the strong radiating lamellæ of the inner zone, continued to the boundaries of the cells, which are strong, prominent and slightly crenulated.

A vertical section shows first, the outer largely vesicular area formed of broad, curved, slightly inclined plates; between this and the inner area there is a fine vertical defining line, within which the plates of the inner zone are seen to be finer and closer than those of the outer, forming a smaller cellular structure; the rows of cells are nearly horizontal near the outer zone, but within seem gradually to bend up and become continuous with the conical cup-like plates forming the axis; those conical plates of the axis seem connected by extremely delicate, irregular, radiating plates; in a rough transverse section the axis appears as a deep conical hollow on the under side. It will thus be seen that in the remarkable cone-in-cone structure of the axis this resembles the Russian *Strombodes mammillare* and *S. astroides* (*Lithostrotion id.* of Lonsdale), from both of which it differs in the axis not being twisted in the terminal star, in the outer zone not being traversed by strong radiating lamellæ, from the former in the much less obliquity of the plates of the outer area, and from the latter by the largely cellular structure of the outer area, as well as the distinctness of all the three areas under every circumstance. In general appearance and imperfect radiation of the outer area it resembles the *S. emarciatum* and *S. floriforme* (*Lithostrotion id.* of Lonsdale), but is distinguished from the first by the rudimentary radiating lamellæ between the primary ones, and from both by the conical structure of the axis, which is formed in them of irregularly twisted vertical plates.

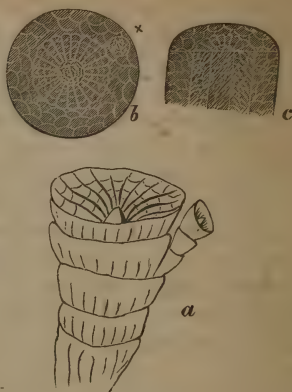
Not uncommon in the carboniferous limestone near Bakewell, Derbyshire.

(Col. University of Cambridge.)

Lonsdaleia (M'Coy), n. g.

Gen. Char. Corallum composed of circular, tapering, proliferous stems, rarely, if ever, laterally united; internally composed of

three areas ; 1st, a cylindrical, defined, complex axis composed of irregularly blended vesicular plates ; 2nd, a cylindrical, defined area of strong, vertical, radiating lamellæ, connected by thin transverse dissepiments, only visible in the vertical section ; 3rd, a wide, largely cellular outer zone between the vertical lamellæ and the external wall of the stem, composed of much-curved vesicular plates extending obliquely upwards and outwards : outer walls of the tubes longitudinally striated and transversely rugose : reproduction by circular germs developed in the cellular outer zone, and springing at once obliquely



Lonsdaleia : a. old branch exterior and terminal cups and young one growing from the side. b. Transverse section showing the three areas and a bud (x) growing in the outer one. c. Vertical section.

without the area of the parent stem, which continues its growth uninterruptedly with the slender young stem projecting from one of the transverse rugosities of the external surface ; the young stem seems at first only composed of the axis, and gradually acquires the inner lamelliferous and outer vesicular zones as it increases in size.

The little-known *Erismatholites Madrepores duplicatus* of Martin's 'Petrificata Derbiensia' may be looked upon as the type of this genus, which I have dedicated to Mr. Lonsdale as a slight token of my admiration for his labours in illustrating the structure of fossil corals. It will be seen from the above notice to unite in itself the internal structure of *Strombodes* (*Lithostrotion*, Lonsd.) with the external character and mode of growth of *Cyathophyllum* (*C. dianthus*, &c.).

Lonsdaleia crassiconus (M'Coy).

Sp. Char. Corallum forming groups or loosely connected masses of elongate-conical stems, averaging 6 to 7 lines in diameter ; surface with concentric wrinkles and coarse flexuous longitudinal striæ ; lateral branches rapidly expanding, conical, widening from their base at the rate of 6 lines in 9 lines of length : horizontal section shows a central circular axis $1\frac{1}{2}$ line in diameter of closely twisted laminæ ; outside which is a circular area 3 lines in diameter, of about twenty-four vertical radiating lamellæ, with few or no connecting vesicular plates between

them; the outer area composed of small, irregular, curved vesicular plates, forming an irregular cellulose texture: *vertical section*, the central axis of close, spirally and conically twisted laminæ; inner area of one row of distant, delicate, irregular, curved transverse plates forming very open cells; outer area defined from the inner, formed of loose irregular cellular tissue, of large, slightly-curved vesicular plates, extending obliquely upwards and outwards.

This species is much less irregularly wrinkled than the *L. duplicata* (Mart. sp.), forms shorter and more widely turbinated masses, and is distinguished externally at a glance by the lateral branches expanding rapidly from their point of attachment to a conical form, while in the *L. duplicata* the lateral branches retain their original small diameter for a great length (increasing at about the rate of 4 lines in 3 inches), and present a strange contrast to the parent stem, as is faithfully shown in the rough figure of Martin.

In the red carboniferous limestone of Arnside, Kendal; also near Bakewell, Derbyshire, in the limestone of the same formation. (Col. University of Cambridge.)

Lonsdaleia rugosa (M'Coy).

Sp. Char. Branches 6 or 7 lines in diameter, elongate-conic, exceedingly rugose with large transverse irregular undulations and funnel-shaped irregularities of growth, crossed by coarse, obtuse longitudinal striæ (four in the space of 2 lines); young lateral branches small, continuing very slender for a considerable length; terminal cups deep, with a prominent compressed axis in the centre, middle portion with strong radiating lamellæ, which, as they approach the margin, become fainter and united into a network by strong interstitial vesicular plates: *horizontal section*, central axis 2 lines wide, of close, fine, complicated laminæ, crossed by one thick mesial plate; axis surrounded by an area 5 lines wide, of about forty-two equal radiating lamellæ, with very few and delicate transverse vesicular plates; outer area partially radiated by delicate prolongations of the radiating lamellæ, with numerous strong curved vesicular plates: *vertical section* shows a thick solid line indicating the *centre* of the axis (and corresponding to the mesial line through the axis of the cross section), from which the delicate, thin, close, complicated laminæ of the axis diverge downwards, but *pass gradually* into the larger and more horizontal cellular tissue of the second area; this latter is separated by a definite line from the outer area, which is of smaller cellular tissue, composed of small, curved, vesicular plates extending obliquely upwards and outwards.

In general appearance this resembles the *L. duplicata* (Mart. sp.), but is much more rugose, and the young branches expand more rapidly; in the vertical section it is distinguished by the central line and the undefined sides of the axis, as well as the very much smaller size of the cells of the vesicular structure, and the much greater number of the radiating lamellæ, which do not exceed twenty-four or twenty-six in that species. There is a slight external resemblance between this coral and the *Cyathophyllum pseudo-vermiculare* (M'Coy), but the prominent axis easily distinguishes it.

Common in the carboniferous limestone of Corwen.
(Col. University of Cambridge.)

Lonsdaleia ? stylastræiformis (M'Coy).

Sp. Char. Corallum composed of easily separable (four- to six-sided) prismatic tubes from 3 to 5 lines in diameter; outer walls faintly striated longitudinally, and marked with arched, transverse, imbricating rugosities: *vertical section*, axis large, defined, composed of irregular, spirally complicated lamellæ; inner area of little-curved, vesicular plates, inclining obliquely upwards and outwards, each plate generally extending from the axis to the circumference of the inner zone, so that there is but one, or occasionally two lengthened cells in a row between those points; outer area narrow, composed of slightly arched plates inclining obliquely upwards and outwards, each plate usually reaching from the inner zone to the outer wall; more rarely a second arched plate is required, so that generally there is but a single row of long cells between the inner zone and outer wall, with occasionally a small irregular cell towards the margin: *transverse polished section* showing a large oval or circular, irregularly reticulated or cellular axis, from which twenty-five lamellæ of equal length and thickness radiate almost to the outer walls, the cellular lining of the walls free of radiating lamellæ being very narrow, and forming apparently a single row of irregular cells; the spaces between the radiating lamellæ crossed by very thin arched plates: *transverse rough fracture* generally cup-like above, the outer zone forming an oblique, nearly uniform margin, faintly undulated in a radiating direction, within which is the rough flat fracture of the inner zone and axis; on the under side the position of those parts is reversed, the inner area being prominent and surrounded by a narrow, radiated border sloping to the walls.

This coral is very remarkable for uniting in itself the internal structure of *Strombodes* (*Lithostrotion*, Lonsd.) with the external form and easily-separable columns of the *Stylastræa* of the same

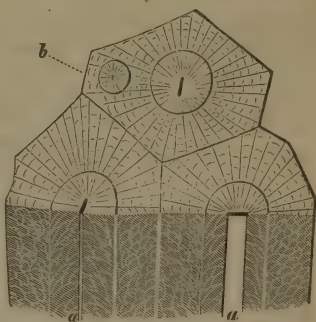
writer. I am unable to afford any information on what would under the circumstances be the most interesting point, namely the mode of production of new columns: taking all the circumstances into consideration, I suspect the mode of increase was similar to that I have described in *Lonsdaleia* generally, the external prismatic form (which is of itself of no value) being produced by the pressure of a closer mode of growth than in the *L. duplicata*. As it is impossible to conceive a *Strombodes* (or *Lithostrotion*) splitting into easily-separable columns, I provisionally therefore place it in *Lonsdaleia*.

Rare in the carboniferous limestone of Kendal.

(Col. University of Cambridge.)

Nemaphyllum (M'Coy), n. g.

Gen. Char. Corallum composed of numerous inseparably united, polygonal, prismatic tubes, each having a straight, thin, flat, fillet-like solid, or nearly solid, axis, from which, in the *horizontal section*, the fine numerous radiating lamellæ are seen extending directly to the walls; radiating lamellæ connected by very fine transverse dissepiments only visible externally in the outer area: *vertical section* shows three distinct areas; 1st, the thin flat axis; 2nd, a sharply defined cylinder of very minutely vesicular arched plates, the rows directed from the axis obliquely downwards and outwards; outside this is the 3rd area of similar small arched plates forming a minutely vesicular structure slightly smaller than that of the inner zone, but the rows directed obliquely upwards and outwards: *reproduction* by small circular buds developed within the area of the parent star.



Section and terminal stars of *Nemaphyllum*: *a a.* axes; *b.* young bud within the area of the parent.

In mode of reproduction and tri-areal structure this genus approaches *Strombodes* (as above understood), from which it differs altogether in the nature of the axis, which in all the species of that genus is cylindrical, composed of numerous plates variously twisted together, and giving a cellulose section in every direction; the axis of the present group on the contrary forms a thin, flat, simply solid lamina, and is exhibited in a vertical fracture either as a narrow opaque white line, or as a broad ribbon-like fillet, according to whether the section is in the direction of its width or

across it; a further difference is constantly observable between those groups in the vertical section, which is, that the interstitial vesicular plates of the inner area in *Strombodes* have their rows either nearly horizontal or inclining obliquely upwards from the axis towards the outer wall, while in *Nemaphyllum* on the contrary they converge towards the axis above and incline downwards and outwards below, so as to meet at a considerable angle those of the outer area which incline in the usual direction upwards and outwards towards the walls; this peculiarity in the inclination of the interstitial vesicular plates of the inner area produces a marked difference in the stars on the weathered surface in the two genera, causing the inner area to form a large prominent oval or conical boss in *Nemaphyllum*, and a flat or deeply hollowed cup in *Strombodes*. A third difference between those generic groups is, that in the latter the vertical radiating lamellæ are principally confined to the inner area, not existing in most of the species at all in the outer area, and do not reach the walls, while on the contrary all the radiating lamellæ in *Nemaphyllum* arise from the outer walls, are strongest in the outer area, and only half of them in general penetrate the inner area. In the latter corals also the whole vesicular structure is much more minute and delicate in stems of the same size than in the others, and the cells of the inner area are larger than those of the outer, which is the reverse of what we find in *Strombodes*. As the young columns are produced from circular buds continuing their development *within* the walls of the parent, it results that the stems are inseparably united; the walls defining the stars being one simple plate, the joint production of the adjacent polypes, cannot be divided, and consequently vertical fractures of the mass, instead of exposing the flat, striated external surface of the stems, pass invariably through the substance of the coral itself, exposing only sections of the interior; the external walls being only seen in those rare cases showing the extreme limits of a mass, or where in a section two masses may have coalesced. Some of the species resemble *Clisiophyllum*, but are distinguished by the peculiar axis and by the cells of the inner area being larger and fewer than those of the outer. The genus is I believe exclusively palæozoic.

Nemaphyllum arachnoideum (M'Coy).

Sp. Char. Stars with from four to seven angles, and averaging from 6 to 9 lines in diameter; axis very thin, 1 line wide: *vertical section*, inner vesicular area wider than the outer, of little-arched plates inclining slightly downwards from the axis; it takes about two of those plates to reach from the axis to the extent of this area, or two irregularly elongate unequal cells

in an oblique line from the axis to the wall of the inner area ; outer area separated from the inner by a sharp distinct line on each side, and composed of much smaller and more highly curved vesicular plates, so that there are from five to seven small, nearly equal, rounded cells extending in a line obliquely upwards and outwards from the inner area to the outer walls of the tube : *horizontal section*, boundary or divisional walls thin, stars radiated with from fifty to fifty-five very thin lamellæ, of equal thickness, but alternately long and short, the long reaching to the centre, the short barely entering the edge of the inner area : *weathered surface*, stars flattened, separated by a depressed line ; inner area forming a gently convex oval or circular boss, with the axis forming a short impressed line in the middle ; the radiating lamellæ exhibit numerous delicate curved interstitial plates in the outer area, but none in the inner area.

This beautifully delicate species is the largest of the genus I am acquainted with, the usual width of the stars being about 7 lines, diameter of the inner area about $2\frac{1}{2}$ lines. It very frequently exhibits the young oval buds within the corners of the old stars, generally but one, very rarely two in a star.

Forms large masses in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Nemaphyllum minus (M'Coy).

Sp. Char. Stars having from four to seven angles and averaging from 3 to 4 lines in diameter ; axis thin, about $\frac{3}{4}$ ths of a line wide : *vertical section*, inner area slightly wider than the outer on each side, composed of slightly curved vesicular plates extending obliquely downwards and outwards, each one nearly reaching from the axis to the external boundary of the inner area, forming thus but one or two cells in each oblique row between those points ; outer area of smaller and more curved plates, forming smaller, more regular and rounded cells disposed in indistinct rows obliquely upwards and outwards, about four in a row from the inner area to the outer wall : *weathered surface*, stars nearly flat, separated by impressed lines, inner area forming a large convex oval or circular boss in the middle of the star and having the axis in the centre ; radiating lamellæ forty-five, thin, of equal thickness, one-half of them reaching the centre, the intermediate ones entering but a short way into the inner zone ; numerous small, curved, interstitial plates between the lamellæ in the outer zone, none visible in the inner one.

This species is allied to the *N. arachnoideum* (M'Coy), but is

constantly distinguished by the smaller size of the stars, fewer radiating lamellæ, and more open internal vesicular structure.

Forms large masses in the carboniferous limestone of Kendal. (Col. University of Cambridge.)

Nemaphyllum decipiens (M'Coy).

Sp. Char. Weathered surface having the stars undefined, the lamellæ of the outer area of adjoining cells appearing continuous, and forming a flat surface, in which the inner area of each star forms a deep cylindrical cell $1\frac{1}{2}$ line in diameter, and about their own diameter apart; in the bottom of those cells the lamellæ rise to form a little cone, from the apex of which projects (when well-preserved) the long thin flat axis, rising to the level of the outer area; on the polished *transverse section* the stars are perfectly defined by distinct walls four- to six-angled, 2 to 3 lines in diameter, with a flat central axis half a line wide, and show the circular germs of young columns in the corners of some of the old stars; radiating lamellæ thin, about thirty-four, of equal thickness, one half reaching the centre, the other barely touching the inner area, which forms a circle about $1\frac{1}{2}$ line in diameter; the radiating plates are connected by numerous curved vesicular plates in the outer area, but few or none are visible in the inner area: *vertical section*, axis thin, solid; inner area of small, curved, vesicular plates extending obliquely downwards and outwards from the axis, about two or three cells in a row; outer area separated from the inner by a thin vertical line, it is composed of small curved vesicular plates, in rows inclining obliquely upwards and outwards, about four cells in a row.

The flat broad spaces between the cups, the seeming continuity of the radiating lamellæ of adjoining stars, and the apparent want of divisional walls between those latter, give the weathered surface of this coral much the aspect of the so-called *Astræa Hennahii* (Lonsd.) of the Devonian rocks; but it is clearly distinguished by the divisional walls appearing distinctly in the horizontal sections, and by the flat, nearly solid axis, which is very obvious both in the polished section and weathered stars.

Not uncommon in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

Nemaphyllum clisioides (M'Coy).

Sp. Char. Stars generally hexagonal and averaging 2 lines in diameter: *weathered surface*, stars defined by a rather thick, prominent, crenulated divisional wall; outer area inclined downwards and inwards to form a shallow cup, in the middle of which the inner area rises into a conical tent-like boss having

the small flattened axis in the centre: *horizontal section*, divisional lines of the stars thin, straight; axis thin, half a line wide; radiating lamellæ thirty-six, thin, one half extending in a flexuous manner from the walls to the centre, the intervening ones also flexuous but of irregular lengths, most of them reaching half-way; transverse vesicular plates very few and delicate, if visible at all: *vertical section*, axis as in the other species; inner area very wide, of large, little-curved vesicular plates, inclining obliquely downwards and outwards; one or two lengthened irregular cells reach from the axis to the outer area; outer area very narrow, of small, much-curved vesicular plates inclining very obliquely upwards and outwards, forming minute rounded cells about two in a row.

This species much resembles some of the massive Astræoid *Clisiophylliæ* of Dana by the conical tent-like aspect of the inner area within the cups or weathered terminal cells; the distinct flattened axis, resembling that of the other *Nemaphylliæ*, will however distinguish it. The flexuous character of the radiating lamellæ in the transverse polished section is remarkable. The *Astræa irregularis* of Portlock's 'Report on Londonderry,' &c., which I know to be a true *Nemaphyllum*, resembles this species in the small size of the stars and flexuous lamellæ, but is easily distinguished by the cells being simply cup-shaped, descending uninterruptedly from the walls to the small, flat, prominent axis in the bottom of the cup, instead of the large tent-like boss formed by the inner zone of the above.

Forms irregular tuberoso masses in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Nemaphyllum septosum (M'Coy).

Sp. Char. Corallum of long, inseparable, slightly diverging five- or six-angled tubes, with an average diameter of 5 lines: *vertical section*, axis straight, thin, flat, three-fourths of a line wide; inner area composed of large, rather distant, slightly arched plates, each of which generally extends across the entire area, so that one lengthened cell (rarely more) reaches from one side to the other of this area, having the axis in the middle; outer area broad, of numerous minute, much-arched vesicular plates inclining obliquely upwards and outwards, about four of the little cells in the oblique line from the inner area to the outer wall: *transverse rough fracture* showing the inner area to be composed of slightly conical or cup-shaped plates, their diameter equal to that of the area, and pierced in the centre by the flat persistent axis: *polished transverse sec-*

tion, radiating lamellæ forty-eight, thin, twenty-four of which reach the centre, while the intervening ones are nearly marginal, not reaching half-way to the inner zone; interlamellar vesicular plates very numerous and delicate in the outer zone, apparently absent in the inner zone.

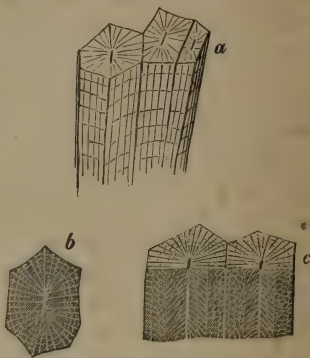
This species has some affinity with the *N. minus* (M'Coy), but is constantly distinguished by the open, simple, subseptate character of the inner zone in the vertical section, the extreme comparative shortness of the alternate lamellæ in the transverse section, and the peculiar character of the broad, simple, cup-like plates of the inner zone in the rough transverse fracture.

Very common in the carboniferous limestone of Tullyard, Armagh, Ireland.

(Col. University of Cambridge.)

Stylaxis (M'Coy), n. g.

Gen. Char. Corallum composed of adjacent polygonal, prismatic, easily separable tubes, internally divided into three areas: *vertical section*, 1st, a thin, flat, straight axis; 2nd, a broad inner area composed of numerous curved vesicular plates in irregular rows converging upwards to the axis; 3rd, an outer area on each side composed of smaller and more curved vesicular plates, in rows inclining obliquely upwards and outwards: *horizontal section* displaying the central flat axis surrounded by radiating lamellæ extending from the walls, and connected in the outer area



a. Mode of growth and division of stem; b. horizontal section; c. vertical section.

by numerous transverse vesicular plates: *additional columns* produced by a bipartite division of the parent stem parallel to one of its faces: polyps distinctly separated above.

The corals of this genus bear precisely the same relation to *Nemaphyllum* that *Stylastræa* (Lonsd.) does to the *Lithostrotion* of the same writer (*Strombodes*) with regard to their mode of development, that is to say, in *Nemaphyllum*, as in *Strombodes*, the increase is by circular buds developed within the walls of the parent stem, the polygonal walls being gradually perfected by the joint labour of adjacent polyps, which it is inferred from their

mode of growth, had a community of existence and organic union at the surface; and from the same cause the columns have no outer surface to exhibit in a rough fracture, but break through the middle rather than separate one from another. In the *Stylaxis* however, as in the *Stylastræa*, the new columns are produced by a sudden splitting of one of the columns into two, the divisional lines commencing along the middle of one face and going directly across to the opposite face, distinctly separating the young four-sided column at once by a double-plated, rectilinear boundary-wall parallel with one of the faces; the external striæ of the old column being traceable upwards into the young one. The columns are easily separable one from another in the rough fracture, and the polyps are inferred to have been distinct from each other, and each to have constructed independently its own boundary-wall.

Stylaxis major (M'Coy).

Sp. Char. Tubes averaging 6 lines in diameter, mostly hexagonal, external surface coarsely striated longitudinally and transversely marked with strong curved irregularities of growth, the convexity of the curves upwards: *horizontal section*, sixty-three slender radiating lamellæ converging from the walls towards the flat central style or axis, which is about 1 line in width; one half of the lamellæ reach the centre, the intervening ones reach half way; outer area exhibiting numerous transverse vesicular plates between the radiating lamellæ: *vertical section*, axis straight, ribbon-like; inner area broad, of slightly curved vesicular plates forming rows of lengthened irregular cells, extending obliquely downwards and outwards from the axis, about three in a row; outer area of rows of small hemispherically-curved plates, including small rounded cells extending very obliquely upwards and outwards, about six in each row.

This species is remarkable for the large size of its tubes and great number of the radiating lamellæ.

From the carboniferous limestone of Derbyshire.

(*Col.* University of Cambridge.)

Stylaxis Flemingii (M'Coy).

Sp. Char. Corallum of very long, prismatic, generally hexagonal, easily separable tubes, averaging 3 lines in diameter; outer surface strongly striated longitudinally, and marked with direct transverse rugosities of growth; bipartite division of the columns frequent: *vertical section* exhibiting the thin flat axis surrounded by an inner zone of small vesicular plates inclining

downwards and outwards from the axis, and an outer zone of small vesicular plates inclined in an opposite direction or upwards and outwards: *horizontal section*, axis thin, half a line wide, surrounded by about forty-three thin, radiating lamellæ from the walls, half of which only reach half way; numerous small, thin, transverse connecting plates between the lamellæ in the outer zone.

The bipartite mode of division of the column is frequently and easily observed in this species, which commonly forms large masses. It greatly resembles externally the *Stylastræa basaltiformis*, but is easily distinguished by the small, but distinct, central axis visible in the transverse fracture, and further by the different disposition of the lamellæ of the inner zone. The small size of the tubes and less number of lamellæ distinguish it from the *Stylaxis major*.

This is probably the *Lithostrotion striatum* of Fleming (Brit. Anim.), as he particularly says, "the rays of the star unite with a small solid central axis." I think however with Mr. Lonsdale, that he is wrong in his references. I have great pleasure in dedicating it to so admirable a naturalist, the extraordinary merit of whose writings on the British marine animals is well known to all who engage in the same laborious and difficult study.

Common in the carboniferous limestone of Derbyshire.
(Col. University of Cambridge.)

Columnaria (Gold. as here redefined).

Gen. Char. Corallum of aggregate, subparallel branches, either round and concentrically wrinkled, or more usually by mutual pressure becoming polygonal and longitudinally sulcated, but always easily separable; internal structure as in *Amplexus*, having many transverse simple diaphragms, and the walls longitudinally sulcated by marginal rudimentary lamellæ, which crenulate the edges of the transverse plates. Increase by fissure of the parent tube or cell, as in *Stylastræa* (Lonsd.). Type of the genus *Columnaria sulcata* (Gold.).

This genus has been erroneously described by Goldfuss in the first instance, and has been misunderstood by nearly every subsequent author—all describing radiating lamellæ from the walls to the centre, and stating that there are no transverse plates; I was rather surprised therefore to find the characters I have given above, in authentic specimens from the Eifel of the *C. sulcata* (Gold.); they also exist in the *C. irregularis* (Münst.), *C. senilis* (Koninek), and the following. I deny the existence in those species of radiating lamellæ near the centre, and find the transverse dia-

phragms conspicuous. The real affinities of the genus seem to be between *Michelinea* and *Amplexus*, differing from the former in the tubes being individually distinct (as in *Stylastræa*) and easily separable by fracture, and being without communicating pores; from the latter it only differs in its compound mode of growth. As thus restricted the genus is no doubt a good one: the other dissimilar species placed in this genus by Dr. Goldfuss and others will easily fall into *Cyathophyllum* and other existing genera.

Columnaria laxa (M'Coy).

Sp. Char. Corallum forming large masses of contiguous, slightly flexuous tubes, rarely in contact; generally round and finely wrinkled transversely, occasionally the tubes in some part of their length touch the adjoining ones, and then become polygonal and longitudinally sulcated; transverse diaphragms undulated, and obliquely inclined in various directions; diameter of tubes from 3 to 4 lines.

The tubes being rarely in contact, and often cylindrical and flexuous, distinguishes this species from its congeners. The transverse diaphragms and absence of radiating lamellæ will serve to separate prismatic portions from the other basaltiform corals found with it.

Not uncommon in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

Michelinea glomerata (M'Coy).

Sp. Char. Cells polygonal, irregularly aggregated, so as to open on every side of the large amorphous masses formed by its irregular mode of growth; cells averaging 2 lines in diameter; internal vesicular plates very irregular, much curved and highly inclined.

This is perhaps most allied to the Russian *M. concinna* (Lonsd.), but as that species is remarkable for the breadth, flatness and horizontality of its internal plates, so this is equally remarkable for their irregularity, convexity, small size, and nearly vertical position, forming in the sections a multitude of small rounded vesicles, without any approach to horizontality. The small size of the cells and mode of growth seem somewhat analogous in both, and separate them at a glance from the three other published species.

Common in the carboniferous limestone of Derbyshire, forming subcylindrical masses 3 or 4 inches long.

(Col. University of Cambridge.)

Michelinea grandis (M'Coy).

Sp. Char. Corallum widely conic, the width considerably exceeding the height, externally marked with thick, rounded, radiating ridges, finely wrinkled across; polygonal cells, on the upper convex surface, averaging 5 to 8 lines in diameter (most near the former at a height of half an inch, most near the latter size at a height of 2 inches), very deep with thin walls not coated by vesicular plates, but having numerous distinct foramina and many longitudinal striæ within; internal vesicular plates small, very thin, much curved, forming nearly horizontal rows of vesicles at the bottom of the cells.

This fine species is most allied to the *M. tenuisepta* (Phil. sp.), but is distinguished by the much wider conical form of the mass and by the cells having, on an average, a diameter three times greater at the same height than in that species, of which I have examined many specimens both British and foreign, and find the figures of Michelin and Koninck, as well as of Prof. Phillips, exact in this respect. Young specimens (1 to 2 inches in diameter) slightly resemble the *M. favosa* (Gold. sp.) in form, having the base much flatter than in the adult, but on comparison with authentic Belgian specimens they are found to be distinguished by the large rounded radiating ridges on the exterior, of which no traces exist in that species, as may be also seen from the figures of Goldfuss and Michelin; the cells also of the present species are, even at that stage, larger, and increased growth destroys all resemblance. The *M. megastoma* (Phil. sp.), which has large cells (although much less than the present species), is distinguished by its mode of growth, it forming large flattened expansions; internally its vesicular plates are much larger, fewer, and highly inclined at the circumference, coating the walls of the cells to their very edge, giving them a peculiar thick tumid appearance, which may be imperfectly recognized in the worn specimen figured by Prof. Phillips, but which distinguishes even fragments from the other four species. Average height of the conical masses $2\frac{1}{2}$ inches, width $3\frac{1}{2}$ inches.

Very common in the carboniferous limestone of Arnside, Kendal.

(Col. University of Cambridge.)

Sarcinula (Lamk.).

? = *Arachnophyllum* (Dana).

The corals of this genus are essentially composed of vertical, cylindrical, transversely septate tubes, with radiating lamellæ within, forming distant circular cells without polygonal bounda-

ries; the tubes are imbedded in a uniform cellulose tissue, from which the buds or young tubes seem to arise whenever the distance becomes great between any two cells, but the young tubes do not seem traceable into the old. The coral referred to by Dana (*Acervularia Baltica* of Lonsdale in the 'Silurian System') as the type of his genus *Arachnophyllum*, I find to have the cell-tubes transversely septate, though not well shown in Lonsdale's figure—the latter genus has therefore no peculiar characters—the cellular structure of the rays being common to several corals.

Sarcinula tuberosa (M'Coy).

Sp. Char. Corallum forming large shapeless masses, the upper surface covered with irregular tuberoso projections, separated by flat or concave spaces, and each having a depressed tubular centre 1 line in diameter, average distance between the centres 5 lines; from the margin of each centre about thirty slightly sigmoidal, very delicate laminæ radiate to the adjoining ones, generally without interruption, the radii connected by numerous small transverse vesicular plates: *vertical section*, centres forming nearly vertical and subparallel cylindrical tubes, with close transverse septa, connected by exceedingly fine uniform cellulose structure, which seems formed of small depressed cells arranged nearly in horizontal layers with a double curve conforming to the projections of the surface: *horizontal section* shows the tubular centres connected by a minute uniform cellular structure with a scarcely appreciable radiation.

This strongly resembles the so-called *Acervularia Baltica* of the 'Silurian System.'

Rare in the carboniferous limestone of Derbyshire.
(Col. University of Cambridge.)

Sarcinula placenta (M'Coy).

Sp. Char. Corallum forming tabular masses about 1 inch thick; under side with small, concentric, imbricating undulations of growth and radiating scratch-like striæ; the upper and lower surfaces parallel and flat; composed of vertical cylindrical tubes forming circular cells at the surface 1 line in diameter, and averaging about 2 lines apart; the intervening space being flat, cellular, and obscurely radiated on the weathered surface by about thirty curved radii: *vertical section*, tubes irregularly transversely septate by vesicular plates; spaces between the tubes composed of slightly waved transverse rows of small, curved, vesicular plates, forming a nearly uniform, minutely cellular structure: *horizontal section*, tubes either plain or

showing more or less of the transverse vesicular plates ; intervening spaces irregularly cellular, but showing a slight disposition to form curved, star-like lines round the tubes.

This interesting coral bears a strong external resemblance to the *Nemaphyllum decipiens* (M'Coy), but is distinguished by having no divisional lines between the stars in either section.

Rare in the carboniferous limestone of Derbyshire.

(*Col.* University of Cambridge.)

Sarcinula Phillipsii (M'Coy).

Ref. ? Phil. Pal. Foss. fig. 15 D.

I have given the above name provisionally to a coral which I believe to be identical with the Flintshire one figured as above by Prof. Phillips, but not named or described. It is closely allied to the preceding species, but is of a thicker growth, the tubes are one-third larger and surrounded by thirty-two to forty strong radiating lamellæ extending to the adjoining tubes, and there is an obvious tendency in the middle of the transverse diaphragms to extend upwards to form an irregularly compressed solid axis, often visible in the weathered cups.

Common in the carboniferous limestone of Corwen.

(*Col.* University of Cambridge.)

Astræa carbonaria (M'Coy).

Sp. Char. Corallum forming very large masses, terminal stars from 9 lines to an inch and a half in diameter, obscurely pentagonal, bounded by narrow, rounded, cellular spaces (no simple divisional walls), having from 107 to 130 thin, jagged, radiating lamellæ, which descend to form an oval or circular cup, and one half of which rise again to form a large oval central boss, in the centre of which the lamellæ become indistinctly blended : *vertical section* shows the uninterrupted passage of the loose vesicular tissue, in gentle curves, from star to star ; a very small space directly under the centre of each star having the vesicular structure almost transverse : *horizontal section* shows the alternately long and short radiating lamellæ, connected throughout by fine transverse vesicular plates, and the former obscurely blended at the centre (no axis), and the irregular cellular structure intervening between the adjacent stars.

This magnificent species is the only apparently true *Astræa* I have yet seen from the palæozoic rocks, the numerous corals of this age described under this generic title by British and foreign authors belonging for the most part to the family *Cyathophyllidæ*,

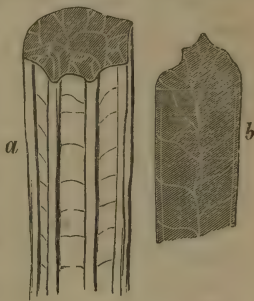
often transversely septate in the middle and having solid polygonal divisional walls to the stars—characters completely at variance with those of the recent and mesozoic *Astræa*, and indicating important differences in the animals and mode of increase.

Abundant in some parts of the carboniferous limestone near Bakewell, Derbyshire; more rare in the same formation at Corwen.

(Col. University of Cambridge.)

Heterophyllia (M'Coy), n. g.

Gen. Char. Stem elongate, subcylindrical, irregularly fluted longitudinally: *horizontal section*, few, distant lamellæ destitute of any order of arrangement, but irregularly branching and coalescing in their passage from the thin solid external walls towards some indefinite point near the centre, where the few main lamellæ irregularly anastomose: *vertical section* showing about the middle an irregularly flexuous line (the edge of one or two of the radiating vertical lamellæ), from which on each side a row of thin, distant, sigmoidally curved plates extends obliquely upwards and outwards, forming a row of large rhomboidal cells on each side.



Heterophyllia: a. exterior of stem; b. horizontal and vertical section.

The paradoxical characters of the lamellæ—their perfect want of symmetry of disposition, and their irregular branch-like union among themselves, together with the remarkable openness of the cellular structure, render those corals totally unlike any other recent or fossil group. From *Cladocora* and *Caryophyllia*, to which they are most allied, they are distinguished by the want of the cellular axis, and by their few, unsymmetrical and anastomosing lamellæ. I suspect the *Cladocora*? *sulcata* of Lonsdale may belong to this group, but I have not seen examples of it myself.

Heterophyllia grandis (M'Coy).

Sp. Char. Stem slightly flexuous, about 5 lines in diameter, scarcely tapering in 3 inches, longitudinally marked with deep unequal grooves, and few, large, polygonal, unequal ridges, giving a very irregularly angulose section to the stem; surface smooth; internal structure as given in the generic character.

Rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

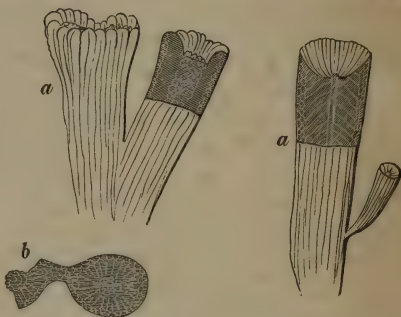
Heterophyllia ornata (M'Coy).

Sp. Char. Stems subcylindrical, long, flexuous, averaging $1\frac{1}{2}$ line in diameter, with about sixteen narrow, subequal, longitudinal ridges sharply defined, and separated by flat spaces rather wider than the ridges they separate, the ridges are set with small round tubercles more than their own diameter apart; surface very minutely granulose: internal structure as in generic character; *horizontal section*, lamellæ about fourteen at the margin.

Rather rare in the carboniferous limestone of Derbyshire.
(Col. University of Cambridge.)

Siphonodendron (M'Coy), n. g.

Gen. Char. Corallum of variously aggregated, branching, cylindrical or elongate-conic stems; young branches produced by lateral buds; outer wall thin, lined by two or three rows of small vesicular plates forming a narrow outer vesicular area in both sections; terminal cups deep, lined by numerous vertical lamellæ, alternately larger and smaller, and having in the bottom a small, prominent, tubular axis: *vertical section* shows a



small, central, persistent, siphon-like tube or axis, which pierces through a series of long, conical or dome-shaped

Recent *Lithodendron*.
a. Mode of growth and vertical section.
b. Horizontal section.

Siphonodendron.
a. Mode of growth and vertical section.

transverse diaphragms occupying the greater part of the width of the tube, the convexity upward, forming in this section lines diverging downwards and outwards from the axis, till they reach the narrow external cellulose layer on each side: *horizontal section* shows the small tube-like axis, surrounded usually by a few thin concentric lines which are the edges of the conoidal diaphragms cut through by the section; from these the vertical lamellæ radiate to the circumference, where they are connected by the small transverse vesicular plates forming the narrow external cellular zone.

I propose this genus for a number of corals exceedingly

abundant in the mountain limestone, but hitherto classed by Prof. Phillips, Mr. Lonsdale, and others with *Lithodendron*. This latter genus was originally proposed by Schweigger (Beobachtungen, &c. tab. 6) to include, 1st, the *Oculina* of Lamarek, including the type of Blainville's *Dendrophyllia*; and 2ndly, a division, which allowing the previously constituted genus *Oculina* to stand for the first division, becomes the real type of his genus, and the four references he gives to Esper's 'Pflanzenziere' as examples of this genus are typical examples of the group subsequently named *Lobophyllia* by Blainville; this latter name therefore becomes a mere synonym of *Lithodendron* and should be laid aside, unless, as many writers seem inclined, it be used for the short, wide species with lobed discs, and thus leave *Lithodendron* for the more slender cylindrical forms: although there is no clear line of separation between the groups, it may be convenient to retain both names for those extreme forms, but in no case can the *Siphonodendra* of the mountain limestone be brought in any close relation with those recent and mesozoic types. The differences are briefly these: 1st, *Siphonodendron* increases by lateral buds,—*Lithodendron* by a lateral elongation and gradual division of the old cup and dichotomous fissure of the stem; 2nd, *Siphonodendron* has a narrow tubular axis and wide conoidal diaphragms, while *Lithodendron* has a large cellular axis and no diaphragms. I have illustrated those points in the accompanying sketch. *Cladocora* of Ehrenberg agrees in external form and mode of branching with *Siphonodendron*, but has the internal structure here represented in *Lithodendron*.

Cladochonus brevicollis (M'Coy).

Sp. Char. Slender stem-like neck of each cell about 1 line long and half a line in diameter, the upper end suddenly swelling to a cup-shaped cell about 2 lines long and 1 line in diameter, curving downwards at an angle of about 135° , the point of junction of the cup and the stem giving origin, at an angle of 45° , to the stem of a second cell similar to the first, but inclining in the opposite direction, and in like manner giving origin from its upper convexity to a third and that to a fourth, &c. perfectly similar cell, forming together an erect, regularly zigzag corallum.

From its regularly angular mode of growth or connexion of the large drooping bell-shaped cups, inclining in opposite directions from thin short slender stems, this is one of the prettiest species of the genus. It most resembles the *C. tenuicollis* (M'Coy) figured in the 'Annals' for October 1847 (Pl. XI. fig. 8), from the carboniferous shales of New South Wales, but is distinguished by its smaller size and much shorter necks to the cells, while, as

in that species, their small diameter compared with their cups distinguishes it from the *C. crassa* (M'Coy) of the carboniferous slate of Ireland.

Rare in the carboniferous limestone of Derbyshire.
(Col. University of Cambridge.)

(*Madreporacea*.)

Dendropora megastoma (M'Coy).

Sp. Char. Stem slightly flexuous, subquadrate, branches few, distant, resembling the main stem in size and shape, and coming off from it nearly at right angles; each face has a row of large oval cells with prominent edges, the sides of which have twelve vertical sulci ending in tubercles; the cells of each row are rather less than twice their diameter apart, the lateral rows opposite, alternating with the other two rows; the width of the cells slightly exceeds that of the face on which they rest, so as to indent the margin; interstices obscurely porospunctate; width of stem about half a line.

This beautiful coral is distinguished from the *D. explicita* (Mich.) from the Devonian beds of Boulogne-sur-Mer by its smaller size and larger cells. Michelin, in his 'Iconographie Zoophytologique,' founds this genus from the last-named coral, and approximates it to the genera *Criserpia* and *Aulopora*; the twelve sulci which I observe to the margin of the cells in this species however show that this cannot be the true affinity of the group, which must now rather be placed in the *Madreporacea* near *Seriatopora*.

I have examined several specimens on a piece of carboniferous limestone from Derbyshire.

(Col. University of Cambridge.)

Palæopora (M'Coy), n. g.

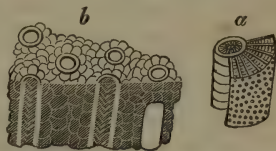
Gen. Char. Corallum polymorphous, generally subhemispherical and concentrically ridged beneath, rarely branched; formed of cylindrical, distinctly walled, tubular cells, having internally twelve vertical sulci or rudimentary lamellæ, and divided at irregular intervals by transverse diaphragms; the tubes surrounded and connected by a uniform minute network of small vesicular plates.

I propose this genus for all the so-called *Porites* of the palæozoic rocks. First described by Goldfuss as *Astræa*, they were removed by Ehrenberg (Ueber Corallenthier des rothen Meeres, &c.) and Lonsdale (Silurian System) to the recent genus *Porites*, in which they were followed—probably without examination—by many writers; Profs. Bronn (Lethæa, &c.), Phillips (Palæozoic Fossils) and others have however much more happily pointed out

their resemblance to *Heliopora*. The distinct walled tubular cells visible in both sections, connected by cellular tissue, with their twelve rudimentary lamellæ, distinguish the present ancient corals from the modern genera just named, for *Porites* has a minutely reticulated corallum impressed by shallow polygonal *undefined* cells on the upper surface, and presenting in the horizontal and vertical sections an uninterrupted uniformly vesicular structure. *Heliopora* agrees perfectly in external appearance, and in the two sections exhibits the same characters of vesicular structure connecting tubular cells with transverse diaphragms, but in it the tubes have eighteen or more rudimentary lamellæ, while they are constantly twelve in the present genus, which I only know as yet in the older and middle palæozoic rocks.

Fistulipora (M'Coy), n. g.

Gen. Char. Corallum incrusting, composed of long, simple, cylindrical, thick-walled tubes, the mouths of which open as simple equal circular cells on the surface, and having transverse funnel-shaped diaphragms at variable distances; interval between the tubes occupied by a cellular network of small vesicular plates.



Fistulipora: a. mode of growth, nat. size, enveloping a crinoid stem.
b. magnified surface and section.

This genus is proposed to include the *Manon cribrosum* (Gold.) of the Eifel, &c., and the two following species from the mountain limestone. They have no affinity with the fossil sponges of the genus *Manon*, with which the only previously known species was classed by Goldfuss and others, but are more allied to the so-called *Porites* of the palæozoic rocks (*Palæopora*, M'Coy), from which they differ in the absence of the rudimentary radiating or vertical lamellæ to the cell-tubes. The sides of the tubes do not seem to be ever perforated by connecting pores.

Fistulipora minor (M'Coy).

Sp. Char. Cell-tubes with slightly prominent margins at the surface, about four in the space of one line, rather less than their own diameter apart, the intervening space composed of from one to three rows of the minute vesicular cells.

The tubes of this species are of so small a diameter that I have not been able to see the diaphragms; they are from half a line to nearly an inch in length according to the age of the example, but not altering materially their diameter or relative distance. It most usually occurs incrusting crinoid stems or other foreign bodies, from which the tubes radiate to the surface, and I suspect

the whole corallum, from the minuteness of its parts, may have been taken for a *Favosites* or *Alveolites*, from which the lens will easily distinguish it by showing the reticulated interstices between the tubes.

Not uncommon in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

Fistulipora major (M'Coy).

Sp. Char. Cell-tubes two-thirds of a line in diameter and about their own diameter apart, their walls thick, of concentric layers, with closely placed funnel-shaped internal diaphragms: interstices minutely vesicular, four to six rows of vesicular cells between each pair of tubes.

The comparatively great size and distinctness of the parts of this coral enabled me first clearly to ascertain the generic peculiarities of the whole group.

Rare in the carboniferous limestone of Derbyshire. (Col. University of Cambridge.)

FORAMINIFERA.

I believe no examples of this group have been hitherto determined in the British carboniferous rocks, which is the more remarkable from their great abundance in the corresponding deposits in Russia, and according to M. de Verneuil* in America. I may mention, that since the publication of M. Ehrenberg's paper on the carboniferous *Foraminifera* in the 'Monats Bericht' of the Berlin Academy, I have diligently sought for the several carboniferous species he describes in the limestone of a great number of different British localities without success. The following is the only species I have met with, and I only know it at present from the one locality.

Nodosaria fusulinaformis (M'Coy).

Sp. Char. Shell of two or more inflated, pyriform, easily separable lodges, the first one having a small mucronate point at its posterior end, and contracted to a very slender, short neck at the anterior end, which joins the pyriform second cell, which is also contracted to a similar minute neck in front; surface smooth. Length of individual cells averaging 1 line, width two-thirds of a line.

So like is this in size and shape to the inflated variety of Fischer de Waldheim's *Fusulina cylindrica* occurring in such quantities in some parts of the Russian carboniferous limestone,

* "Note sur le parallélisme des dépôts paléozoïques de l'Amérique Septentrionale avec ceux de l'Europe," &c., Bulletin de la Soc. Géol. de France, 2^e série, vol. iv.

that it might easily be mistaken for it; it is destitute however of the longitudinal external fissure-like opening and complex internal structure of that genus, seeming more properly allied to certain moniliform, few-celled *Nodosariæ*, such for instance as the *N. rudis* and *N. rugosa* of M. D'Orbigny's work on the Austrian Foraminifera, with both of which species it agrees almost perfectly. The lodges or cells are almost always found separated (from the minuteness of the connecting neck), which gives them the striking resemblance to *Fusulinæ* above alluded to; I have heard however of several of them having been found united in a line by their little necks, and I have myself seen two thus united, and the posterior cell not being a terminal one.

Occurs in great numbers on the weathered surfaces of the carboniferous limestone in the parish of Shivey, Tyrone, in the north of Ireland.

(Col. University of Cambridge and Royal Dublin Society.)

Exclusive of the above species, the following is a list of such British corals of the carboniferous period as I have myself noted since the publication of Morris's Catalogue of British Fossils in addition to the species there given; it includes, 1st, some species described by foreign authors which I have recognized in Britain; 2nd, a few Devonian species for which I give undoubted carboniferous localities; and 3rd, those new forms which I have figured and described in the 'Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland' published some years ago, the result of an examination of the collections made in that country by Mr. Griffith of Dublin, with whose permission I now however, for the first time, publish the principal geological and geographical localities, the omission of which in the work mentioned has often been regretted. All the localities except those in *italics* are in Ireland. All the species in *italics* are in the Geological Museum of the University of Cambridge. The following abbreviations are used of the rocks: *Ar. L.* Arenaceous Limestone, a peculiar band in the middle of the yellow sandstone at the base of the carboniferous series; *Calp.* a provincial term for a band of dark argillaceous limestone occurring between the great lower and upper limestones, accompanied in the north of Ireland by thick beds of shale and a little sandstone; *C. L.* Carboniferous Limestone generally; *C. Sh.* Carboniferous Shale generally; *C. Sl.* Carboniferous Slate, the shales between the base of the lower limestone and the top of the yellow sandstone, alternating more or less with each at the points of junction; *L. L.* Lower Limestone, the great limestone of Ireland, between the Calp and the carb. slate; *U. L.* Upper Limestone, a thinner deposit than the lower limestone, occurring between the Calp

and the millstone grit. *Y. S. Yellow Sandstone*—a thick sandstone at the base of the carboniferous system in Ireland, occupying the space between the carboniferous slate and the old red sandstone, and by many geologists considered to belong to the latter; I have recognised however in the shales intercalated with it nearly the same suite of fossils which we find in the carboniferous slate and in the Calp, and in the beds of arenaceous limestone occasionally occurring in it I have identified the most characteristic fossils of the main or lower limestone, so that no doubt remains in my mind of the correctness of Mr. Griffith's original view, that this sandstone forms the true base of the carboniferous limestone formation.

ALVEOLITES.

- Goldfussi* (Michel. sp.), Icon. Zooph. L. L. Hook Head, Wexford.
 ? *palmata* (M'Coy). *Flustra* id., Syn. Carb. Foss. Irel.
 Calp. Manor Hamilton.

ASTREOPORA.

- antiqua* (M'Coy), Syn. Carb. Foss. Irel. C. Sl. Hook Point.

AULOPORA*.

- campanulata* (M'Coy), Syn. Carb. Foss. C. Sl. Hook Head.
gigas (M'Coy), Syn. Carb. Foss. of Irel. Calp. Ballintrillick.
serpens (Gold.), Petrefacten. Calp. Bundoran.

BERENICEA?

- megastoma* (M'Coy), Syn. Carb. Foss. C. Sl. Hook Head.

CANINIA.

- cornu-bovis* (Mich.), Icon. Zooph. C. L. Corwen.
cornu-copie (Mich.), Icon. Zooph. C. Sh. Red Castle, Mt. Rath;
 Glasgow; *I. of Man*.
flexuosa (Gold. sp.), Petrefacten. C. L. Kendal.
gigantea (Mich.), Icon. Zooph. { C. L. Easky, Sligo.
patula (Mich.), Icon. Zooph. { C. Sh. Castletown Bay, *I. of Man*.
 C. Sl. Hook, Wexford.

CAUNOPORA.

- placenta* (Phil.), Pal. Foss. C. Sl. Poulscadden Bay, Howth.

CERIOFORA.

- affinis* (Gold.), Petrefacten. C. Sh. *I. of Man*.

CLADOCHONUS.

- antiquus* (M'Coy), *Jania* id., Syn. Carb. Foss. C. Sh. Rahan's Bay; St. John's
 Point, Donegal.
bacularius (M'Coy), *Jania* id., Syn. Carb. Foss. C. L. Derbyshire.
crassus (M'Coy), *Jania* id., Syn. Carb. Foss. { C. L. Derbyshire.
 { C. Sh. Lisnapaste; Lackagh.

* If the small recent and newer fossil corals referred to the genus *Alecto* really belong (as seems the general opinion now) to the *Polyzoa*, there could be no hesitation in considering the comparatively gross palæozoic species not only as generically distinct, but as belonging to a different order—the sulcation visible within the tubes of several of the species clearly indicating rudimentary radiating lamellæ, which, as they exceed twelve in number, place those corals among the *Anthozoa*,—most probably, I think, near *Syringopora*, in which a similar sulcation has been detected. Instead therefore of considering the words *Alecto* and *Aulopora* as synonymous, we may, with advantage, retain each for the peculiar section of the group indicated.

CYATHAXONIA.

cornu (Mich.), Icon. Zooph.

C. L. Kendal.

spinosa (Kon. sp.), Anim. Foss. Belg.

C. L. I. of Man.

DICTYOPHYLLIA.

*antiqua** (M'Coy), Syn. Carb. Foss.

C. Sl. Hook.

FAVOSITES.

Gothlandica † (Gold.), Petrefacten.

C. L. Derbyshire; I. of Man.

inflata (Kon.), Anim. Foss. Belg.

C. L. Kendal.

FENESTELLA.

antiqua (Lonsd. Devonian var.), Geol. Trans. vol. v.

{ Y. S. Bruckless.

{ C. Sl. Blackball Head, Cork; Currens; Clonea; Clonmel, &c.

carinata (M'Coy), Syn. Carb. Foss.

{ C. L. Derbyshire; I. of Man; Tynan; Mountmellick.

crassa (M'Coy), Syn. Carb. Foss.

{ Calp. Malahide.

ejuncida (M'Coy), Syn. Carb. Foss.

L. L. Ballynacourty; Kildare.

L. L. Cork.

formosa (M'Coy), Syn. Carb. Foss.

{ C. L. Derbyshire.

{ Calp. Malahide, Dublin.

frutex (M'Coy), Syn. Carb. Foss.

{ U. L. Killymeal, Dungannon.

hemisphærica (M'Coy), Syn. Carb. Foss.

{ U. L. Killymeal, Dungannon.

Morrisii (M'Coy), Syn. Carb. Foss.

L. L. Cork.

L. L. Cork.

multiportata (M'Coy), Syn. Carb. Foss.

{ C. L. Cork; Killymeal.

{ Calp. Ballintrillick.

oculata (M'Coy), Syn. Carb. Foss.

C. Sl. Ballynacourty, Dungarvan.

plebeia (M'Coy), Syn. Carb. Foss.

{ C. Sl. Poulscadden.

{ L. L. Cork; Howth; Derbysh.

quadridecimalis (M'Coy), Syn. Carb. Foss.

{ Calp. Bundoran; Ballintrillick.

varicosa (M'Coy), Syn. Carb. Foss.

{ U. L. Black Lion, Enniskillen.

{ U. L. Black Lion, Enniskillen.

GLAUCONOME.

bipinnata (Phil. var.), Pal. Foss.

{ C. Sl. Ballynacourty; Poulscadden.

{ Calp. Bundoran.

gracilis (M'Coy), Syn. Carb. Foss.

{ U. L. Killymeal, Dungannon.

{ C. Sl. Ballynacourty, Red Castle, Mt. Rath.

{ Calp. Ballintrillick.

{ U. L. Killymeal, Dungannon.

grandis (M'Coy), Syn. Carb. Foss.

L. L. Meelick Chapel, Co. Clare.

pulcherrima (M'Coy), Syn. Carb. Foss.

C. Sl. Hook Head.

GORGONIA?

Lonsdaliana (M'Coy), Syn. Carb. Foss.

C. L. Laracor, Trim.

ziczac (M'Coy), Syn. Carb. Foss.

Ar. L. Granard.

* More lately figured by Michelin (Icon. Zooph.) under the name of *Michelinea compressa*.

† It is several years since I first published this as a carboniferous coral from a single Irish specimen, concerning the locality of which some doubt was expressed. I have now examined a large suite from the Derbyshire limestone, and compared them minutely with authentic specimens of Goldfuss's coral from the Eifel, and am enabled fully to confirm my original observation.

HEMITRYPA.

Hibernica (Sc. sp.), M'Coy, Syn. Carb. Foss.

{	L. L. Cork.
	Calp. Ballintrillick.
	U. L. Knockninny; Black Lion.

ICHTHYORACHIS.

Newenhami (M'Coy), Syn. Carb. Foss. C. L. Meelick Chapel, co. Clare.

MILLEPORA?

gracilis (Phil.), Pal. Foss.

C. Sl. Ballynacourty; Lisnapaste.

similis (Phil.), Pal. Foss.

C. Sl. Toberyellathan, Gort; St. Doolaghs, Dublin.

NEMAPHYLLUM.

aranaea (M'Coy). *Astræa* id., Syn. Carb. Foss.

C. L. Magheramore, Tobercurry.

PETRAIA.

<i>bina</i> (Lonsd. Devon. var.), Phil. Pal. Foss.	{	Y. S. Bruckless.
<i>celtica</i> (Lamx. sp.), Phil. Pal. Foss.		C. Sl. Currrens, Tralee.
<i>pauciradialis</i> (Phil. sp.), Pal. Foss.		C. Sl. Clonea; Knocklofty.
<i>pluriradialis</i> (Phil. sp.), Pal. Foss.		C. Sl. Currrens; Ballynacourty.
		C. Sl. Currrens, Castle Island.

POLYPORA.

<i>dendroides</i> (M'Coy).	{	Ar. L. Townparks, Killeshandra.
		C. Sl. Red Castle, Mt. Rath.
<i>fastuosa</i> (Kon. sp.), Anim. Foss. Belg.	{	L. L. Hook Head.
<i>marginata</i> (M'Coy), Syn. Carb. Foss.		U. L. Killymeal.
		U. L. Killymeal, Dungannon.
<i>papillata</i> (M'Coy), Syn. Carb. Foss.	{	Ar. L. Townparks, Killeshandra.
		L. L. Rathgillen, Nobber.
		U. L. Black Lion, Enniskillen.
<i>verrucosa</i> (M'Coy), Syn. Carb. Foss.	{	C. L. Derbyshire.
		C. Sh. Red Castle, Mt. Rath.

PTILOPORA.

pluma (Sc. MSS.), M'Coy, Syn. Carb. Foss.

{	C. Sl. Poulscadden, Howth; Hook.
	L. L. Kildare.
	Calp. Malahide.

RETEPORA.

undata (M'Coy), Syn. Carb. Foss. L. L. Kildare.

SIPHONODENDRON.

pauciradiale (M'Coy). *Lithodendron* id., Syn. Carb. Foss.

C. L. Magheramore, Tobercurry.

STENOPORA.

scabra (Rafin. sp.). *Favosites* id., Kon. Anim. Foss. Belg.

C. Sl. Hook; Clonea; Currrens.

STROMBODES (*Lithostrotion*, Lonsd.).*emarciatum* (Lonsd. sp.), Geol. Russ. and Ural. C. L. Derbyshire.

VINCULARIA.

<i>dichotoma</i> (M'Coy), Syn. Carb. Foss.	{	L. L. Howth; Kildare.
<i>megastoma</i> (M'Coy), Syn. Carb. Foss.		U. L. Black Lion, Enniskillen.
<i>raricostata</i> (M'Coy), Syn. Carb. Foss.		U. L. Killymeal.
		U. L. Killymeal, Dungannon.

CHAPTER V.*

PALÆOZOIC ECHINODERMATA.

CRINOIDEA. (*Articulata*.)*Cupressocrinus* (Gold.).

It will be observed in the following descriptions of two species of this genus hitherto only known in the foreign Devonian strata, that I have attributed interscapular plates to its cup as in *Poteriocrinus*, although such are not indicated in the figures or generic characters of Goldfuss. I have however detected them in an authentic specimen of his *C. crassus* from the Eifel in the Cambridge collection, although not so clearly as in the following species. In the number and position of the plates of the body, *Cupressocrinus* and *Poteriocrinus* are identical; and in both, the articulations for the arms extend the entire width of the upper edge of each of the scapulæ; but there is a striking difference in their form, which seems dependent on the total dissimilarity of their arms; the cup in the latter genus is elongate-conic, the comparatively narrow scapulæ giving off arms of moderate width, dichotomizing frequently, while in *Cupressocrinus* the cup is of an extremely wide saucer-like form, and the scapulæ of inordinate width to give origin to the curiously wide, massive, simple arms which render the genus so remarkable.

Cupressocrinus calyx (M'Coy).

Sp. Char. *Cup* very wide, evenly convex, saucer-shaped, three times wider than long; *pelvis* small, slightly concave, pentagonal, of five pentagonal pieces; alternating with and above which are five large first-costals, their length and width equal to the diameter of pelvis, four pentagonal and one with a very short sixth side; alternating with, and above those, are five pentagonal scapulæ, as long as the costals, but the width double the length; to the short side of the hexagonal costal is obliquely attached a long pentagonal intercostal supporting two very small interscapular plates; *scapulæ* very thick,

* The new species described in this chapter date from the 'Annals of Natural History' for April 1849.

articular surface flat with an articular ridge running its whole width; all the plates slightly convex and smooth. Width of cup 9 lines.

Rare in the carboniferous limestone of Derbyshire.
(*Col.* University of Cambridge.)

Cupressocrinus impressus (M'Coy).

Sp. Char. *Cup* four times wider than deep; *pelvis* concealed in a deep circular pit, out of which spring the broad ends of five ovato-lanceolate first-costals, the apex of one of which is truncated to support a small elongate interscapular plate, and on its side rests a somewhat larger intercostal plate; *scapulæ* about one-third wider than long, pentagonal, the two lower sides concave, and the lower angles very much prolonged to fit between the lanceolate costals; substance of the joints very thick, projecting far into the visceral cavity, a strong perforated articular ridge runs across the top of the scapulæ; all the plates slightly convex and smooth.

Distinguished from the *C. calyx* by its deeply impressed pelvis and long, lanceolate first-costals.

Not very uncommon in the carboniferous limestone of Derbyshire.

(*Col.* University of Cambridge.)

(*Semiarticulata.*)

Poteriocrinus nuciformis (M'Coy).

Sp. Char. *Body* subovate, pointed below, constricted above from the upper margins of the scapulæ being narrower than their lower portion; *pelvic plates* very small, form unknown; first-costals long, pentagonal, very narrow below, giving a pointed appearance to the lower portion of cup; second costals large, tumid, subhexagonal, nearly twice the length of the first-costals, a little less wide than long; *scapulæ* pentagonal, about one-third wider below than above, giving a very perceptible, constricted appearance to the upper part of the cup, articulations apparently the whole width of the plate; irregular intercostal large, subhexagonal, supporting two small pentagonal interscapulars; surface smooth. Length of cup 8 lines, greatest diameter (at second costals) 7 lines.

This closely resembles the *P. Bockschii* figured by Geinitz in his 'Grundriss der Versteinerungskunde,' t. 23. f. 13, but of which no description or definition has been published.

Not uncommon in the carboniferous limestone of Derbyshire.
(*Col.* University of Cambridge—two examples.)

Poteriocrinus crassimanus (M'Coy).

Sp. Char. Column small, of thin circular joints; supracolumnar joint supporting five pentagonal first-costals, slightly wider than long, between and above which rest five pentagonal *scapulæ* about as long as the costals, but about one-third wider than long, each of which supports one large cuneiform *arm-joint*, wider than long, from each of which proceed two *hands* of six joints each, thicker on alternate sides, the last joint cuneiform and supporting two *fingers* of about thirty-five joints, each wider than long; costal and scapular plates radiatingly marked at their margins. Length of cup $3\frac{1}{2}$ lines, width 6 lines, length of rays 2 inches.

Of the arms visible one has but four joints, one has seven, and the other three visible have six each. This species differs from the *P. radiatus* (Aust.) by the slighter radiation of the plates, the greater proportional width of the cup, the articulation of the arm-joint extending the full width of the scapulæ, the latter distinction being very striking as well as the consequent greater strength of the rays. The surface seems obscurely granulose, but is not distinctly preserved.

Rare in the carboniferous limestone of Hook Head, co. Wexford.

(Col. University of Cambridge.)

*(Inarticulata.)**Platycrinus vesiculosus* (M'Coy).

Sp. Char. Body spheroidal, depressed; visceral portion hemispherical, deeper than the cup; *pelvis* pentagonal, small, flattened; *scapulæ* small, rotundato-quadrate, one-third wider than long, very thick, gibbous, slightly concave in the centre, lower edge hanging below the pelvis, excavation for the first arm-joints very small, round, marginal, less than one-third the depth of the scapulæ; visceral plates very large, irregular, polygonal, some of them nearly equalling the scapulæ in size, they are moderately convex, and each rendered rugged by several small tubercular projections; mouth lateral, surrounded by small plates. Length of small specimen from pelvis to vertex 6 lines, width 8 lines.

The very large, bubble-like tuberculation of the visceral plates and the small, gibbous scapulæ give a most peculiar aspect to this species, quite unlike any other I am acquainted with. I find the characters very constant.

Not uncommon in the carboniferous limestone near Bakewell, Derbyshire.

(Col. University of Cambridge.)

Platycrinus diadema (M'Coy).

Sp. Char. *Body* very much depressed, spheroidal (from the base of pelvis to the vertex one-third less than the diameter between the arms); *pelvis* large, depressed, pentagonal, without divisional lines; columnar adherence circular, crenated, one-third the diameter of the pelvis, but seated in the bottom of a deep circular excavation three-fourths the diameter of the pelvis; *scapulæ* hexagonal, nearly twice as wide above as below, about one-third wider than long, very slightly convex except at the articulation for the arms, which are prominent, very large, broad, and two-thirds the depth of the plate; interscapular plate large, hexagonal; visceral plates rather small, hemispherical. Height from pelvis to vertex 1 inch.

The very wide, depressed, turban-like form of this species (which I find constant) easily distinguishes it from its congeners. All the plates are even and smooth.

Not uncommon in the white decomposing encrinal beds of carboniferous limestone at Cleenish, co. Fermanagh, north of Ireland.

(*Col.* University of Cambridge and Royal Dublin Society.)

Platycrinus megastylus (M'Coy).

Sp. Char. *Body* broad ovate, visceral portion convex, not much elevated; *cup* rapidly expanding, conical; *pelvis* pentagonal, very small, resembling a prominent rim to the very large circular columnar attachment, the diameter of which is three times greater than from its circumference to the edge of the pelvic plate; *scapulæ* slightly convex, even, nearly twice as wide above as below, little wider than long; excavations for the arm-plates large, nearly half the depth of the scapulæ; capital plates variable in size and number, but large, few, unequal, polygonal, and most of them presenting a large conical protuberance in the centre; entire surface smooth. Length of body 10 lines, width between the arms 9 lines.

This species is excellently figured by Prof. Phillips (*Geol. Yorksh.*) with a doubtful reference to the *P. lævis* of Miller. The latter species is, I believe, generally admitted now to be distinct, but having examined specimens agreeing with the above figure, I find the species to which it belongs differs both from that to which Goldfuss and that to which Mr. Austin have referred it, by the comparatively enormous size of the columnar attachment, and the narrow prominent rim to which the rest of the pelvic plate seems reduced.

The specimens above described are from the carboniferous limestone of Bolland, where it occurs in company with numbers

of the *P. pileatus*, Gold. (*P. antheliontes*, Aust.), which it much resembles, but from which it is easily distinguished by the above characters.

(Col. University of Cambridge.)

Actinocrinus (Amphoracrinus ?) olla (M'Coy).

Sp. Char. Inversely pyriform, very gibbous; *arm-bases* small, not very prominent; *cup* below the arms hemispherical, visceral portion above very wide, elevated, cylindrical; all the plates above and below flattened; *pelvis* small, flattened, pentagonal, supporting on four of its sides four large hexagonal first-costal plates, about one-third wider than long, and on the fifth side one pentagonal plate; the five regular second costals are scarcely one-third wider than long, smaller than the first-costals and hexagonal, with the two upper lateral sides so short as sometimes to make the plates seem quadrangular; intercostals hexagonal, longer than the first-costals; pectoral plates rather large, flat, polygonal; *scapulæ* pentagonal (or occasionally with the upper lateral angles truncated so as to be slightly heptagonal), one-third shorter than the first-costals; interscapulars heptagonal or octagonal, as long as the intercostals; the surface of all the plates marked with minute vermicular wrinkles. Diameter of cup 1 inch 9 lines.

The sculpturing resembles that of the *A. (Amphoracrinus) amphora*, from which the species is distinguished by its round inflated pot-like figure, small arm-bases, proportionate length of the costals, &c.

Very common in the Derbyshire carboniferous limestone in company with the *Poteriocrinus granulosus*.

(Col. University of Cambridge.)

Actinocrinus (Amphoracrinus) Atlas (M'Coy).

Sp. Char. General figure of *body* elongate-oval, diameter between the arms little more than half the height of the body; *pelvis* pentagonal, of three thick flattened joints; *first-costals* small, one pentagonal and five wider heptagonal, the latter nearly twice as wide as long; *second costals* as long as the first, but only one-third wider than long, hexagonal or sometimes quadrate (according as the upper lateral angles are entire or slightly truncated); *scapulæ* short, pentagonal, as wide as the second costals; *intercostals* hexagonal, exceeding the first-costals in length; arm-bases prominent, and over each is an elongate conical tubercle; *pectoral plates* rather large, convex and irregularly polygonal; *vertex* covered by a very large hemispherical plate, surrounded by six slightly smaller polygonal ones

having a large conical protuberance in the middle; *mouth* longitudinally oval, rather nearer the vertex than the arm-base over the pentagonal first-costal, to which it inclines; all the plates except the large ones of the vertex marked with minute vermicular wrinkles. Length from pelvis to plate on vertex $1\frac{1}{2}$ inch, diameter between the arms 10 lines.

The enormous size of the visceral portion above the arms (nearly three times the height of the cup) has suggested the specific name for this crinoid, which resembles the *A. (Amphoracrinus) Gilbertsoni* and *A. (Amphoracrinus) amphora* in its markings, prominent tubercles over the arm-bases and great plates on the vertex; but it differs from those, besides the great size of the visceral portion, very obviously in the greater proportional length and less width of the costals, most remarkably of the second series.

Rare in the carboniferous limestone of Bolland.
(Col. University of Cambridge.)

Eucalyptrocrinus polydactylus (M'Coy).

Sp. Char. (Small concave *pelvis* not seen); *first-costals* hexagonal, convex, one-third wider than long, each supporting a quadrangular *second costal*, nearly twice as wide as long, its width nearly one-third less than that of the first costal; on each second costal rests a pentagonal *scapular* joint, equalling the second costal in width but exceeding it in depth; on each scapula rest two hexagonal *first arm-joints* nearly equalling the scapulæ in width and depth, and joining by their inner margins (so that the interbrachial plates cannot rest on the scapulæ); on each of these rests a smaller hexagonal *second arm-joint*, from each of which arise *two hands of four or five fingers each*; between the two second arm-joints of each arm is a small heptagonal *interbrachial* plate, its inferior pointed end resting on the two first arm-joints, and its truncated upper end supporting the small lozenge-shaped plate peculiar to this genus; circumscribed by the first and second costal, scapular, and first arm-plates, are the five large, equal, convex, nine-sided *intercostal* plates, each supporting on its upper edge a vertical row of three hexagonal interbrachial plates. Diameter of cup about $1\frac{1}{4}$ inch.

Besides the differences of proportion in the various plates which may be gathered from the description, this differs from the *Hypanthocrinus (Eucalyptrocrinus) decorus* (Phil.) and *E. rosaceus* (Gold.) in the lateral union of the first arm-joints, and their supporting the interbrachial plates, instead of the scapulæ, the scapulæ consequently being pointed above; also in the plates resting on the intercostal not being bifid, and most remarkably

from all of the genus in the number of fingers, there being but two to each hand in the other species.

Rare in the Wenlock limestone of Dudley.

(Col. A cast in the University collection at Cambridge.)

BLASTOIDEA.

Pentremites campanulatus (M'Coy).

Sp. Char. Bell-shaped, base as wide as the body; pseudambulacra* wide above, tapering to the angles at the base; transverse suture between the first and second series of supra-basal plates nearly medial; base flattened; surface minutely granulated. Length 3 lines, width 3 lines.

If we suppose the lower third abruptly cut off a *P. ellipticus*, we should have a good idea of this little species, which agreeing with the above in most characters is distinguished by its small size, more tapering ambulacra, greater proportional width and wide base.

Rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Codaster (M'Coy), n. g.

Etym. κώδων, *tintinnabulum*, and ἀστὴρ, *stella*.

Gen. Char. Cup conical, with the upper part broad, flat, truncate; *pelvis* deep, conical, of three pieces, one tetragonal and two pentagonal, each having its inner apex notched to form part of the round columnar canal; on the upper edges of these rest five large equal first supra-basal plates which reach to the truncated summit, to which from their mesial gibbosity they give a pentagonal outline; in the centre of this superior disc the mouth seems situated, and from it five prominent, minutely porous pseudambulacra diverge, one to each angle, each being placed on a thick tapering ridge divided by a mesial sulcus; from the re-entering angles of those ridges four other thick, rapidly tapering ridges proceed, one to the middle of each of four of the straight sides, each ridge at its thick, oral end shows an obscure impression, probably of the ovarian pores; the fifth space is without a ridge, being occupied by a large, ovate or lozenge-shaped (? anal) opening;



Flat terminal disc
of *Codaster*.

* I use the word pseudambulacra here to designate those poriferous rows in *Pentremites*, &c. which resemble ambulacra, but the pores of which are found by MM. Roemer and Yandell (Bulletin de la Soc. Géol. de France for 17th April 1848) to be really the alimentary canals of a double row of little jointed tentacles resembling I imagine those of *Pseudocrinites*.

the depressed, triangular intervening spaces are marked with coarse, rough parallel striæ nearly coinciding in direction with the pseudambulacral ridges, and converging to the second set of ridges; the impressed lines between these striæ *seem* punctured, the fifth (? posterior) space is without sulcation.

These strange and beautiful forms, the 'bell-stars,' as they may be called, are obviously allied to *Pentremites* (taking *P. Derbyensis*, *florealis*, *oblongus*, *ellipticus*, and such like as the types of the genus), from which they differ in having the small basal plates enormously developed into a conical pelvis, and having the pseudambulacra entirely confined to the capital plates (which here form a truncated disc) instead of being continued through a slit in the supra-basal plates nearly to their base. On the nature of the peculiar sulcation, represented in the subjoined sketch in four of the interambulacral spaces, I have no remark to offer. In Prof. Forbes's paper on the British *Cystidea* in the second volume of the 'Memoirs of the Geol. Survey,' p. 529, there is a figure representing "the projection of the arm-bearing surface of the *Pentremites pentagonalis*," which resembles the disc of our genus except in having the posterior interambulacral space sulcated, and with a thick mesial ridge like the rest; I do not suppose that that figure is meant to represent the *Platycrinus pentagonalis* of Miller, forming the *Pentremites id.* of G. Sowerby and Phillips, which presents no resemblance of the kind. I only know the following two species, from the carboniferous limestone.

Codaster acutus (M'Coy).

Sp. Char. Pelvic and supra-basal plates of equal length; pelvis acutely conical, obtusely subtrigonal in section; columnar adherence small, round, prominent; surface smooth. Length 6 lines, width of disc 5 lines.

Not very uncommon in the carboniferous limestone of Bolland.
(*Col.* University of Cambridge.)

Codaster trilobatus (M'Coy).

Sp. Char. Supra-basal one-third longer than the basal or pelvic plates; pelvis divided into three tumid lobes which hang below the columnar adherence; surface smooth. Length 7 lines, width of disc 5 lines.

Not uncommon in the carboniferous limestone of Derbyshire.
(*Col.* University of Cambridge.)

Ord. PERISCHOECHINIDA (M'Coy).

All the known Echinida—from the spheroidal *Echini* with the mouth and anus both central, one vertically under the other, to the elongated, symmetrical *Spatangi* with their mouth and anus at

opposite ends of the ventral disc—all agree in having their case made up of twenty vertical rows of plates, ten ambulacral and ten interambulacral. This is not only the most persistent character of the entire group, but the number becomes of extreme interest when, with Agassiz and Valentin, we view the globose test of the sea-urchins as a mere modification of the same parts which we find in a 5-rayed starfish,—an ideal division of the mesial suture connecting the two rows of plates in each interambulacrum of the former, giving at once the ambulacra, lateral ossicles, and other characters of the latter. The Echinites of the palæozoic rocks however are constructed on an entirely different plan, having *three* or more rows of interambulacral plates, instead of two as in those of the newer rocks and existing seas; as therefore those sea-urchins differ from all of the order Echinida in the great number of rows of plates in the test, usually having an odd number of rows in the interambulacra, and the consequent impossibility of theoretically dividing them at the sutures into five equal parts, I would propose to form a peculiar order for their reception under the above title, indicating the complexity of their structure. I first drew attention to the structural peculiarities of those fossils in 1844 in my ‘Synopsis of the Carb. Limest. Fossils of Ireland’ (p. 171 to 174), where I gave the generic characters of the genus *Palæchinus* (proposed in manuscript by my friend Dr. Scouler), and described and figured several species having from three to five rows of plates in the interambulacra. In the same work I stated that the plates of the so-called Cidarites of the carboniferous period being hexagonal was a proof that they too must have had, like the *Palæchini*, more than two rows of interambulacral plates, and being consequently distinct from the newer fossil and recent *Cidaris*, I mentioned that I had long distinguished them in manuscripts (in the collections at Dublin) under the name of *Archæocidaris*. In that work I withdrew my own name however in favour of *Echinocrinus*, by which M. Agassiz had announced his intention of designating the carboniferous *Cidaris Nerii*, &c. in his Introduction to the 2nd livr. of his ‘Monog. des Echinod. Fossiles,’ p. 15: although he did not either define the genus or recognise the aforesaid peculiarities, the name itself seemed to indicate an entirely different affinity, namely with the Crinoidea, in which group this generic name is placed in Agassiz’s ‘Nomenclator Zoologicus.’ I propose to resume now my old name for this genus, 1st, because M. Agassiz neither indicated the affinities nor gave any descriptive notice of the genus *Echinocrinus*, while I have done both for my *Archæocidaris*; 2nd, several of the continental geologists have not followed my example in rejecting my own name, but prefer *Archæocidaris*; 3rd, in the ‘Catalogue Raisonné des Echinodermes,’ &c., published by MM.

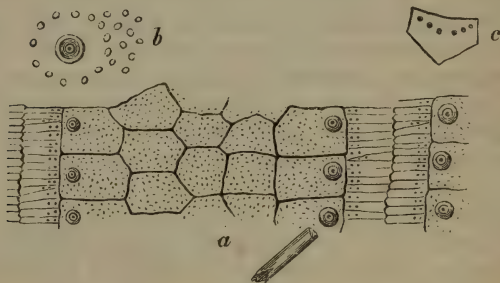
Agassiz and Desor in the 'Annales des Sc. Nat.' for November 1846, no mention is made of the genus *Echinocrinus*, but the species which were to have formed the type of it (*Cidaris Nerii*, &c.) are given under the new title of *Palæocidaris*, which of course has no claims for adoption on the score of priority; nor do MM. Agassiz and Desor even there seem aware of the peculiarity in form of the interambulacral plates or their abnormal number, although my observations on those points are mentioned by M. Verneuil nearly two years before in his 'Coup d'œil général sur la Faune Paléozoïque de Russie,' prefixed to the second vol. of MM. Murchison, Verneuil, and Keyserling's great work on Russia and the Ural Mountains. Under those circumstances, therefore, it seems the most simple and correct course to use the term *Archæocidaris* for those fossils.

The order *Perischoechinida* may be divided into two families: 1st, *Palæchinidæ*, having the interambulacral plates crowded with small, subequal, spinigerous tubercles, not perforated, the spines of one form (including *Palæchinus*, *Melonites*, Owen and Norwood, &c.); 2nd, *Archæocidaridæ*, having the spines and tubercles of two forms and sizes, the primary spines very large, generally muricated, crenulated at the base, and each supported on a large mammillated and perforated primary tubercle surrounded by an elevated ring, never more than one on any plate, generally surrounded by a crowd of the small secondary tubercles (including *Archæocidaris*, M'Coy, and the following). These family divisions rest on the same characters as the separation of the true *Echini* and the *Cidaridæ* among the normally formed *Echinida*.

Perischodomus (M'Coy), n. g.

Etym. *περισχῶν*, *complexus*, and *δῶμα*, *domus*.

Gen. Char. Spheroidal, depressed, subpentagonal; ambulacra



- a. Diagram of portions of interambulacrum and ambulacra of *Perischodomus*.
- b. One of the primary and some of the secondary tubercles magnified more highly.
- c. One of the ovarian plates.

narrow, of two rows of small plates, most usually of a transversely elongate pentagonal figure, and each pierced by one pair of simple pores; interambulacra wide, of five rows of plates very irregular in size and shape, all the plates covered with small equal granules or secondary tubercles, while the row on each side adjoining the ambulacra alone bear the small, smooth primary spines, one on each, the supporting tubercle being small, mammillated, perforated, but not crenulated, surrounded by a double ring and situated not in the centre, but near the ambulacral edge, a little above the middle; ovarian plates pierced each with six foramina; mouth and anus small, both central.

This genus is remarkable for the irregularity of form and size of the interambulacral plates, differing in this both from *Archæocidaris* and *Palæchinus*; from the former it also differs in the greater number of the interambulacral plates being destitute of the mammillated primary tubercle, and by its small size and lateral position on those plates which do bear it; from *Palæchinus* it differs, besides the above, in the two rows of primary tubercles to each interambulacrum, &c. I at present know but one species.

Perischodomus biserialis (M'Coy).

Sp. Char. Diameter (of flattened specimens) about $2\frac{1}{2}$ inches, width of ambulacra at middle 3 lines; width of mouth and ovarian circle each about 3 lines; granules on the five rows of irregular interambulacral plates scarcely visible, the two rows of mammillated and perforated primary tubercles bordering the ambulacra very small; two rows of ambulacral plates, about six or seven occupying the same space as one of the interambulacral plates of the middle of the row.

Some few of the ambulacral plates are wedge-shaped, pointed towards the interambulacra, as in the sketch. The primary spines, as far as seen, were cylindrical and smooth.

Rare in the lower carboniferous limestone of Hook Head, Wexford.

(*Col.* University of Cambridge (anal and genital half), and Dr. Griffith at Dublin (oral half).)

CHAPTER VI.*

CRUSTACEA.

THE class Crustacea having received less attention from British palæontologists than perhaps any other of similar importance, I have put together in the following pages a few observations I have been able to make on the examples in the collection of the University of Cambridge, as well as on a great number of specimens of the same species, for the most part finely preserved, lent me by various friends to render my observations as perfect as possible. I have given descriptions of some of the best-marked new species, also of some new genera; I have endeavoured to refer some others, hitherto improperly placed in recent genera, to the various fossil genera established by foreign writers for cognate forms, and have ventured a few suggestions on the classification and systematic position of some of the groups.

Class CRUSTACEA.

Ord. PODOPTHALMA. Tribe DECAPODA.

(Brachyura.)

Of this the most highly organized group of Crustacea, I believe the following genera have been quoted from British rocks without sufficient authority: viz. 1. *Zantho* (Leach); this has been quoted with doubt by Desmarest, Bronn, &c. from the London clay; I have ascertained that the crustacea referred to are of an extinct genus, more nearly related to *Pilumnus* than to *Zantho*, which I have named *Zanthopsis*. 2. *Orithya* (Fabr.): M. Deslongchamps referred with doubt a crustacean originally discovered by Sir Henry de la Beche in the greensand of Lyme Regis, to this recent genus of natatory *Brachyura*; I find however that the species referred to (*O. Labechii* of Desl. Mém. de la Soc. Linn. de Normandie, Morris's Catalogue, &c.), and some similar forms from the gault, form a peculiar genus intermediate between *Ho-*

* The new genera and species in this chapter date from the 'Annals of Natural History,' for September, November, and December, 1849.

mola and *Corystes*, and belonging not to the *Brachyura* but to the *Anomura*, for which I have proposed the name *Notopocorystes*. 3. *Inachus*: Desmarest (Crust. Foss.), Morris (Catal.), and several other authors have quoted a species of this genus as found fossil in the London clay:—the figures and descriptions which I give below, from an abundance of perfect specimens which I have examined, leave no room for doubt that the fossil in question does not belong to the *Brachyura* but belongs to the *Anomura*, and forms a particular genus allied to *Notopus*, *Dorippe* and the like, to which I have given the name *Basinotopus*. 4. *Corystes* (Latreille): the gault fossils referred to this genus in Morris's 'Catalogue' belong to the same Anomurous genus as the so-called *Orithya*.

Zanthopsis (M'Coy), n. g.

Gen. Char. Carapace suborbicular or transversely oval, gibbous, strongly arched from before backwards; gastric region very large, tumid, depressed in the middle towards the insertion

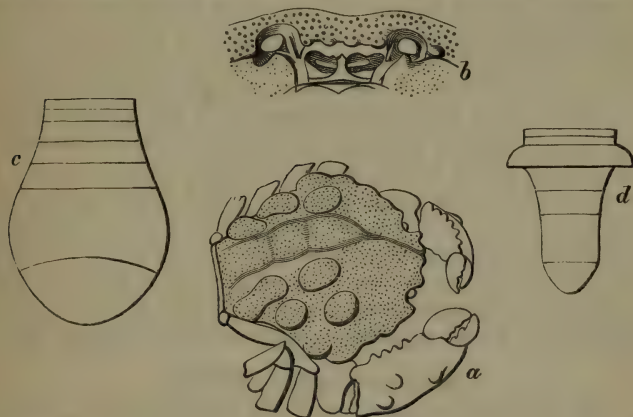


Diagram of the genus *Zanthopsis*.

- a.* Entire animal as far as known; *b.* view of the front from below, showing the internal antennæ lodged in their transverse fossæ, and the position of the outer pair in the inner canthi of the orbits; *c.* abdomen of female, nat. size; *d.* ditto of male, nat. size.

of the *genital region*, which is very small, pentagonal, and not extending more than one-third the length of the carapace towards the front, generally divided by a transverse depression into two portions, the hinder of which is most prominent and equal in width to the *cardiac* and *intestinal regions*, which are longer than broad, and form together a tumid ridge of three obtuse oblong nodules (defined by a hollow along each side smoother than the rest of the carapace); *branchial regions* with

four large tubercles, two before and two behind, the inner posterior one elongate obliquely backwards and outwards; *front* four-lobed (including the prominent inner angle of the orbit); *orbits* large, the two lateral and the inferior angles prominent; *latero-anterior margin* with about three tubercles or spines on each side, the posterior pair largest, placed at the greatest width of the carapace, and in a line with the sulcus separating the genital and cardiac regions; *surface* minutely and closely pitted; *antennæ* as in *Zantho* (outer pair in the inner canthi of the orbits, inner pair in deep transverse fossæ beneath the front); *eyes* on very short peduncles; *tail* of seven distinct pieces in both sexes; *first pair of feet* forming robust, unequal chelæ; *hand* subcompressed, nodulated, with the upper and inner edge tuberculato-dentate; *fingers* short, with few large obtuse teeth; *four hind pair of feet* moderate, subequal, slightly compressed, smooth.

The *Cancer Leachii* (Desm.) may be looked on as the type of this genus; it was referred to *Cancer* or *Zantho* by Desmarest (Consid. sur les Crust. fos.) and to *Cancer* by Milne-Edwards (Suites à Buffon), from the want probably of good specimens. It is nearer to *Zantho* by its tuberculated carapace, few tubercles on the latero-anterior margins, and position of the external antennæ at the inner canthi of the eyes, instead of between these and the front; but it differs in the great convexity of the carapace, and materially from both those genera in *both* sexes having seven separate joints in the tail, showing in this a closer relationship with *Pilumnus*, from which however the strong nodulation of the hind part of the carapace and its oval, vaulted form, as well as the quadrilobed front and great extent of the gastric region, distinguish it. I only know the genus from the London clay.

Zanthopsis nodosa (M'Coy).

Sp. Char. *Carapace* about one-seventh wider than long, very gibbous in the middle, sloping gradually to the sides, more rapidly towards the posterior margin, falling most rapidly and with an abrupt curve towards the front; anterior half broadly rounded, each antero-lateral margin with three large, obtusely rounded, nodular tubercles gradually diminishing towards the front; tubercles of the branchial regions very prominent as large obtuse nodules; *gastric region* tumid with a shallow depression along the middle; *genital region* small, prominent, strongly divided by a wide transverse depression, posterior half most prominent, obscurely bilobed; hollow space on each side of the mesial regional ridge remarkably smooth; *chelæ* of the male rather larger than of the female, the upper ridge of the right (large) hand with six or seven conical tubercles, that of the

left with about four, outer side of each hand with two very obscure small tubercles near the carpus, and one much larger but less distinct near the origin of the fingers; two blunt teeth on the inner edge of each finger; *tail* of the female broad ovate, of the male narrow hastate, terminal joint triangular, about $\frac{1}{3}$ th wider than long, penultimate joint the same length but a little wider, third joint much wider than the others, but shorter than the fourth or fifth. Length about 1 inch 9 lines, width 2 inches.

Common in the London clay of Sheppey.

(Col. University of Cambridge and Mr. Bowerbank.)

Zanthopsis bispinosa (M'Coy).

Sp. Char. Carapace transversely oval, about one-fifth wider than long, gently convex, two posterior pair of tubercles of the antero-lateral margin forming short, flattened, sharp spines, the anterior one forming a small, very obtusely angular projection; crest of the large hand with four or five tubercles, outer side with two strong elongate tubercles near the carpus, and one large obtuse one near the origin of the fingers; *tail* of the female broad oval, the last and the penultimate joint of equal length, the latter twice as wide as long, fifth joint half the length of the penultimate.

This is considerably wider and flatter than the *Z. nodosa*, and the tubercles on the branchial regions and those formed by the genital, cardiac and intestinal regions are much less prominent; the hollow space along each side of the ridge formed by the medial regions is punctured almost as strongly as the rest of the carapace; the tubercles on the ridge of the hand are fewer, but those on the outer side much more strongly marked; it is moreover easily distinguished by the two hind pair of tubercles of the antero-lateral margins forming depressed sharp spines in the one and large obtusely rounded nodules in the other. Length of carapace 1 inch 9 lines, width 2 inches 3 lines.

Common in the London clay of Sheppey.

(Col. University of Cambridge and Mr. Bowerbank.)

Zanthopsis unispinosa (M'Coy).

Sp. Char. Carapace suborbicular, length and width nearly equal, evenly gibbous, sloping almost equally to the front and to the back; tubercles of the branchial and medial regions nearly obsolete, flattened, obscurely defined; antero-lateral margin with the posterior tubercle on each side forming a strong, short, depressed triangular spine, the two anterior pair almost obsolete, each indicated by a faint wave in the margin. Length of carapace 1 inch 6 lines, width 1 inch 8 lines.

This rare species is distinguished from the common *Z. nodosa* and *Z. bispinosa* by its more uniform convexity and by the orbicular form produced by the length so nearly equaling the width, as well as the single, angular, pointed spine on each side. The different projections on the posterior half of the carapace are much less strongly marked than in the other species, though having the same form and position.

Rare in the London clay of Sheppey.

(Col. University of Cambridge.)

Of this genus (*Zanthopsis*) authors describe from the London clay at Sheppey the *Cancer Leachii* (Desm.), which from the imperfection of the specimen described originally (even the margins of the carapace being absent), I do not think it is possible to recognise with any certainty. Also belonging to it and from the same locality is the *Brachyurites hispidiformis* of Schlotheim (Nachtr. z. Petrefactenk. t. 1. f. 3), which for a wonder has escaped insertion in my friend Mr. Morris's elaborate 'Catalogue'; it has the exact form and strong nodulation of the *Z. nodosa*, but having the two posterior pair of spines even more produced and slender than in the *Z. bispinosa*.

Podopilumnus (M'Coy), n. g.

Gen. Char. *Carapace* having the front and antero-lateral margins forming a semielliptical curve, antero-lateral margins not compressed, tumid, obtusely rounded, with about three small spinose tubercles; front narrow, slightly projecting, deeply four-lobed (including the inner angles of the orbits), with a shallow furrow extending a short way on the back from the middle notch; *orbits* large, oval, lower margins denticulated, a small fissure in the under margin at the outer angle (and a doubtful trace of one in the upper margin); posterior lateral margin straight, longer than the anterior, converging towards the truncated base; posterior half of the carapace flat-

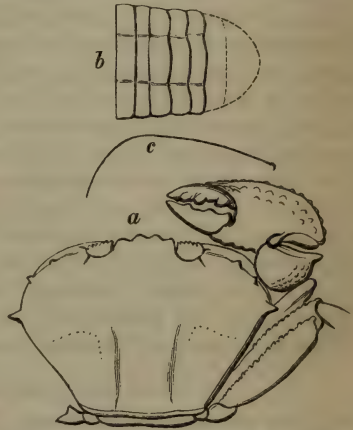


Diagram of the genus *Podopilumnus*.

a. Carapace, thighs and chelæ; *b.* abdomen of female, the two last dotted joints put in from their impressions on the breast-piece; *c.* profile of carapace showing the abrupt downward curve of the front.

tened, anterior half abruptly sloped downwards towards the front; whole surface even and nearly smooth, the only regions defined are the cardiac and intestinal, which are marked by shallow furrows (*P. Peruvianus*); sides minutely granular; abdomen of the female broad oval (apparently of seven joints); four hinder pair of feet subequal, slightly compressed, very long, the thigh (or third joint) alone equaling the posterior lateral margin of the carapace in length; *chela* short and strong.

So far as the imperfection of the specimen allows of examination, the most striking difference between the present genus and the recent *Pilumnus* consists in the great proportional length of the legs, which are rather longer and more slender than those of the *Galene Natalensis* of Krauss (see his Südafrikanischen Crust. t. 1. f. 4), to which it bears some resemblance; the tail of the female is more ample, and the tumid rounding of the antero-lateral margins and their small uncompressed spines contrast strongly with the similar parts in the recent genus. The only two known species are the following, and the so-called *Portunus Peruvianus* figured by D'Orbigny in the geological volume of his great 'Voyage dans l'Amérique méridionale' (t. 6. f. 17), of uncertain origin, but which he suspected to have come from the cretaceous beds of the Cordillera; a view I think confirmed by the geological place of the second species of the genus, which therefore at present would seem confined to the cretaceous system, and is I believe the oldest of the genuine *Brachyura* known.

Podopilumnus Fittoni (M'Coy).

As this is the only accessible species of the genus, it will be sufficient, in addition to the above characters, to add the following particulars:—Length of carapace 1 inch 5 lines, width 1 inch 9 lines, general surface smooth, sides minutely granular; *hands* about 7 lines wide and 1 inch 1 line long, the obtusely keeled upper edge with five or six obtuse tubercles, the outer surface minutely shagreened and bearing three or four irregular longitudinal rows of small tubercles; *fingers* short, curved, rounded on the outer edge, and with three or four blunt teeth on the inner edge; *tail* $6\frac{1}{2}$ lines broad, only the five proximal joints preserved, but the fifth being about the same length as the fourth, it is probable the remaining two were distinct, it being generally at that part of the tail that anchylosis occurs in those genera which have less than the normal number of abdominal or tail segments.

Greensand of Lyme Regis.

(Col. University of Cambridge.)

(Anomura.)

Basinotopus (M'Coy), n. g.*

I propose this genus for the reception of a very common crustacean of the London clay at Sheppey, originally figured and

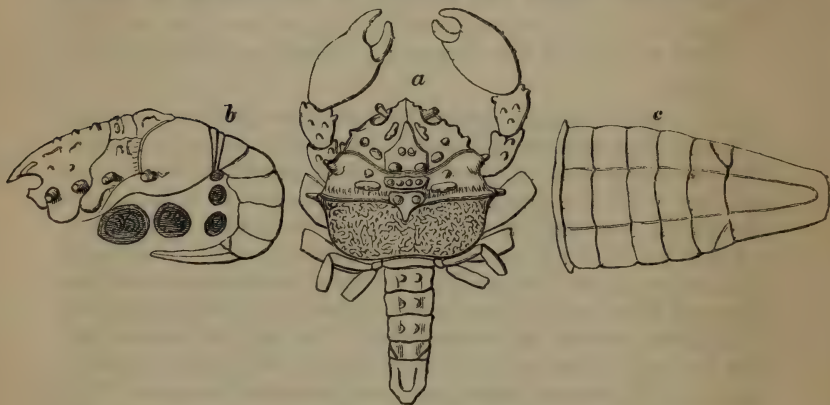


Diagram of the genus *Basinotopus* (nat. size).

- a.* Male specimen seen from above; *b.* profile of female specimen showing the tumid pterygostomial region and the elevation of the two hinder pair of legs over the third pair; *c.* abdomen of female, showing the triangular intercalated pieces between the fifth and sixth joints.

described by Desmarest in his 'Histoire naturelle des Crustacés Fossiles' under the name of *Inachus Lamareckii*, but which I have ascertained, from the examination of numerous finely preserved specimens, not to belong to the genus *Inachus*, nor even to the Brachyurous division, but is truly Anomurous, retaining the little triangular plate between the fifth and sixth joints of the tail, indicating the presence of a caudal fin in the young, and also having the two hind pair of feet disproportionally small and elevated as in *Homola*, *Dorippe* and *Notopus*, &c., from all of which it differs in the large peculiar posterior or basal space behind all the other regions on the carapace (from which the genus derives its name), besides other less striking characters. As there is but one species known, which never has been very fully described, I subjoin a description comprising the generic and specific characters for the present.

* On recognizing at first the Anomurous nature of this fossil, I thought it might be the generic type named *Dromilites* by Dr. Milne-Edwards in the number of 'l'Institut' for August 1837 from Sheppey, but having lately had the pleasure of showing him the specimens, I find that though closely allied they are yet distinct.

Basinotopus Lamarckii (Desm. sp.).Syn. *Inachus Lamarckii* (Desm.).

Carapace broad ovate, very slightly longer than wide, gibbous; *rostrum* short triangular, deeply channeled, bent downwards and with a small tooth on each side, a strong rough tubercle on each side of the base forming the inner angle of the orbits, another tubercle forms the outer angle, and from this to the level of the base of the cardiac region the margin bears four strong spinous tubercles; the *gastric region* extends half the length of the carapace, is strongly trilobed, the middle portion (corresponding to the so-called *genital region* of many crabs) tumid, subpentagonal, the pointed end extending to the level of the orbits; it bears one large rounded tubercle at each side of its base, and several irregular smaller ones between those and its apex; the lateral portions of the gastric region are less prominent and have an oblique ridge formed by the confluence of two or three tubercles parallel with the converging sides of the middle portion; below those near the nuchal* furrow is a large cleft tubercle, and sometimes between those and the orbit two or three small granules; a slight hollow separates the gastric from the small square *hepatic regions*, which correspond on each side to the two anterior marginal spines, each bears one tubercle in its middle; *pterygostomian regions* very tumid, mammillated; *branchial regions* very large, each divided about the middle by a strong, prominent transverse ridge extending from the cardiac region to the fourth (or last) great marginal spine; the anterior edge of this ridge is plicated, and the space between it and the nuchal furrow bears two tubercles, the anterior smallest; the large, peculiar basal space behind these ridges is continuous from side to side behind the intestinal region; it is closely pitted and rough with minute wrinkles; *genital region* forming a narrow transverse tuberculated ridge, its length being only one-fourth of its width, which equals that of the *cardiac region*, which is very gibbous, rotundato-quadrate, and bearing a large hemispherical tubercle on each side; *intestinal region* forming only a small mucro, imperfectly separated from the cardiac, and not extending more than half-way into the rough basal space towards the posterior margin; *abdomen* of six joints, in the male narrow, with nearly parallel sides, obscurely trilobed longitudinally, the first joint very

* I use this term to designate that most important and constant of all the furrows of the carapace—namely that which runs transversely across the back, forming the posterior boundary of the gastric and anterior hepatic regions; it is especially strong, and frequently the only furrow, in the carapace of the *Macrura*, and corresponds on the back to the line of separation between the cephalic and thoracic segments beneath—the *neck* as it were, whence the name.

small and smooth, second, third and fourth each with a pair of tubercles on the elevated middle portion, fifth smooth, with a small triangular piece (remains of the embryonic tail-fin) on each side between it and the sixth or last joint, which is subpentagonal and rather more than twice the length of the fifth; tail of the female broad ovate, smooth, trilobed; *anterior pair of feet* forming short robust chelæ, with scattered spinose tubercles; the others small and smooth, the two hinder pair abruptly smaller and elevated above the rest. Length of carapace 10 lines, width 9 lines.

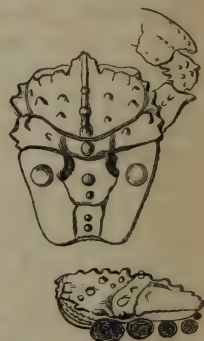
Common in the London clay of Sheppey.

(Col. University of Cambridge and Mr. Bowerbank.)

Notopocorystes (M'Coy), n. g.

Etym. *νώτος*, *dorsum*, *πούς*, *pes*, and *Corystes*.

Gen. Char. Carapace longer than broad, ovate, depressed, with scattered tubercles, anterior half broadly rounded and furnished with a few strong marginal teeth; posterior lateral margins acute, straight, rapidly converging towards the base, which is narrow and deeply emarginate; *front* forming a short triangular rostrum, depressed in the middle, and with a small mesial ridge; *orbits* large, transversely oval, complete below and above, with two longitudinal fissures in the upper margin; *gastric region* very large, rhomboidal, defined posteriorly by a strong obtusely angular nuchal furrow pointing backwards, slightly convex, extending nearly the width of the carapace, leaving a very small obscurely defined *hepatic region* on each side; *genital region* very small, about twice as wide as long, not dividing the gastric region; *cardiac region* moderately large, hexagonal, with a small deep lunate fossa on each side at its junction with the genital region; *intestinal region* narrow; *branchial regions* large, each divided by a shallow furrow proceeding from the base of the genital region to the lateral margin on each side, parallel with the nuchal furrow; *pterygostomian regions* very tumid; first pair of feet short, robust, didactyle spinulose; fifth pair of feet disproportionally small and elevated above the level of the others; *abdomen* of the male narrow (? six-jointed).



Back view and profile of *Notopocorystes*.

This little genus completes the chain of affinities between the recent genera *Homola* and *Corystes*, rendering the transition per-

fect from the *Anomura* to the *Brachyura*. In the general form of the carapace, of the rostrum, in the completeness and form of the orbits with the two fissures in their upper edge, it so exactly resembles *Corystes* as to have even deceived Dr. Leach, the first crustaceologist of his day (see Mantell's Geol. of Sussex, p. 97). I first suspected its anomorous nature from observing the faint sulcus dividing the branchial regions as we so commonly see in the short-tailed *Anomura*, and subsequently was gratified by the Woodwardian Inspectors with the sight of a little specimen of the *N. Mantelli* (M'Coy) in the old cabinet left by Woodward to the University of Cambridge, showing the chelæ and bases of all the feet, proving the posterior pair to be abruptly smaller than the preceding ones and elevated above them, and completely establishing the position of the genus: curiously enough, the entry of this specimen in Woodward's MS. Catalogue indicates the same analogy with the recent form which Dr. Leach pointed out so many years afterwards. This genus includes the "*Corystes*" of Leach and Mantell (Geol. Suss. p. 129. figs. 9 & 10), also the species figs. 13, 15, 16 of the same plate, and the "species of a new genus allied to *Arcania*," figs. 7, 8, 14 of the same plate, which is also the *Orithya Bechei* of Deslongchamps (Mém. de la Soc. Lin. de Normandie). Dr. Mantell in the above plate, fig. 15, shows a large joint in the abdomen below the fifth large one; the specimen of the tail which I have seen is broken before the end of the fifth joint, so that I have no independent authority for the sixth joint or its mode of junction with the fifth, or whether the supplementary side pieces occur between them.

Notopocorystes Mantelli (M'Coy).

Sp. Char. Greatest width of *carapace* (at base of gastric region) one-fifth less than the length; three strong teeth on the antero-lateral margin, the middle one largest, placed at the end of the nuchal sulcus, the lower one between the first and the end of the faint branchial sulcus, at the end of which a fourth small tooth is found; *gastric region* with a narrow mesial ridge from the rostrum bearing three small tubercles on its posterior half; each side of this region has a row of three tubercles running parallel with the gastric or nuchal furrow, the space between them being about equal to their distance from that furrow; behind the inner tubercles of each row is one rather smaller; the *genital region* bears one elongate tubercle in the middle; *cardiac* and *intestinal regions* with a mesial ridge, the former bearing two large and the latter two small tubercles; *branchial regions* with an obtuse boss close to their upper internal angle, and two equidistant tubercles on each side in an oblique line to the second marginal tooth close under the

nuchal sulcus ; *pterygostomian regions* marked with large longitudinal furrows and a few rows of sharp granules ; surface minutely granulated. Length from 9 lines to $1\frac{1}{4}$ inch.

I suspect that the figures in Mantell's 'Geology of Sussex,' t. 29. figs. 15 & 16, and possibly 9 & 10, may belong to this species, though rather more elongate than the specimens I have seen. The *N. Bechei* (Deslong. sp.) is broader, more quadrate, and has vertical rows of tubercles on the branchial regions. I have a sincere pleasure in dedicating this species to the indefatigable geologist, who in one of the earliest of his many valuable geological works, has given the only figures I believe extant of all the species of the genus.

Not uncommon in the greensand of Lyme Regis and in the gault of Folkestone.

(Col. University of Cambridge.)

Pagurus? platycheles (M'Coy).

Sp. Char. *Hands* nearly equal, very much compressed, broad ovate, width nearly three-fourths the length, the moveable finger little smaller than the other ; *carpus* trigonal, not so long as wide ; *surface* closely covered with very obtuse granules of unequal sizes. Length of left hand 10 lines, of right hand 8 lines ; width of left hand 7 lines, of right 5 lines ; length of *carpus* 4 lines, width nearly 5 lines.

One interesting specimen in the collection at Cambridge shows the two strong crustaceous hands *in situ*, while all trace of the body and abdomen have disappeared, which could scarcely have happened unless, as in the recent Hermit Crabs, those parts were almost membranous ; close under the right hand is a clear sparry cavity apparently indicating the place occupied by the soft perishable abdomen. The granulation of the surface resembles that of an *Echinus*. The species is remarkable for the width and brevity of its hands and wrists.

Not uncommon in the great oolite of Minchinhampton.

In connection with the group *Anomura* I may say a few words on a crustacean described and named *Ammonicolax longimanus* by Mr. Pearce (see Annals for September 1842), which he supposed to form a new genus of Hermit Crabs inhabiting the *Ammonites*. It seemed to me very incautious to infer that the *Ammonicolax* lived in the *Ammonites* on no better ground apparently than their co-existence in the Oxford clay at Christian Malford, and on recently examining two authentic specimens presented by Mr. Pratt to the University collection at Cambridge, I found that so far from being *anomurous*, the species had a well-

developed abdomen, caudal fins, remarkably large false feet, and all the characters of the *Macrura*, being in fact clearly referrible to the genus *Mecochirus* of Germar, so abundant in the upper oolitic schists of Bavaria, though not hitherto recognised in Britain. The five internal processes mentioned on each side are merely the indications of the *apodemata* or internal partitions between the gills, and present no peculiarities. As the specific name *longimanus* would be peculiarly inappropriate when this interesting little crustacean is placed in its true genus (nearly all the species of which have longer hands), it might provisionally bear the name of *Mecochirus Pearcei*.

(*Macrura*.)

In this group we find several fossil crustacea referred to recent genera in British works, without, I believe, just reason:—thus in Morris's Catalogue we find *Palinurus Seurii* quoted from Leeds, Yorkshire;—if this muschelkalk fossil is found there, it should be placed in the Triassic genus *Pemphix*, formed many years ago for it by Von Meyer, it having no relation to *Palinurus*. The recent generic name *Astacus* has also been much used for fossils of various ages, but I have not yet seen or heard of the real occurrence of that genus in the fossil state; most of the species will be noticed below under their respective genera.

Eryon Barrovensis (M'Coy).

Sp. Char. *Carapace* subovate, about one-eighth broader than long near the truncated posterior margin; *lateral margins* set with short tooth-like spines, two narrow incisions on each side, the hind pair a little in front of the middle, inclosing between them on each side a short rotundato-quadrate lobe; *front* narrowed, concavo-truncate, with the lateral angles slightly produced outwards; each of the *inner pair of antennæ* having their two setæ deeply divided, the outer one of each slightly longest, scale of the external antennæ large, the setæ scarcely thicker than those of the inner pair; *abdomen* exceeding the length of the carapace by only one-third the length of the outer tail-flaps, which latter are very broad and subquadrate at the end (resembling those of the *Eryon Hartmanni*); each of the segments except the first bears a large, oblong tubercle in the middle; *first pair of legs* robust, short, hand and carpus together nearly one-fourth less than the length of the middle of the carapace; *fingers* very slender, both pointed, of equal length, incurved at the tip, the moveable one most abruptly. Surface minutely granulated, with larger granules on the mesial ridge of the carapace. Length of carapace 2 inches, width 2 inches 2 lines; length of abdomen (to end of outer pair of

tail-flaps) 2 inches 2 lines ; length of hand 1 inch 3 lines, of carpus 4 lines, width of hand at middle $3\frac{1}{2}$ lines.

This is most allied to the only other liassic species which I am aware of, namely the *E. Hartmanni* of Herman von Meyer (see his "Beiträge zu Eryon" in the 18th vol. of the Nova Acta Acad. Cæs. Leop. Carol. &c.), from which it differs in its much shorter abdomen, a character which approximates it to the otherwise dissimilar *E. subpentagonus* (Münst.) and *E. arctiformis* (Schlot.) of the Kelheim and Solenhofen lithographic slates. In all the species described by Von Meyer and Münster the hand and carpus taken together equal or exceed the middle of the carapace in length ; this species is therefore most remarkably distinguished by the comparative shortness of its chelæ as well as their greater robustness.

Rare in the lias of Barrow-on-Soar.

(Col. University of Cambridge.)

Archæocarabus (M'Coy), n. g.

Etym. ἀρχαῖος, *antiquus*, and κάραβος, Aristotle's name for the *Palinurus* or spiny lobster.

Gen. Char. *External antennæ* very thick and long, the setæ of very short fimbriated joints ; *first pair of feet* much thicker than the others, the extremity of the penultimate joint dilated on its inner side to a broad, subtruncate, subcompressed hand as wide as the length of the curved terminal joint which is inflexed on it ; *four posterior pairs of legs* slender, compressed ; *carapace* semicylindrical, obtusely rounded above ; *nuchal furrow* very wide and deep, extending with a gentle backward curve across the carapace in front of the middle ; cephalic por-

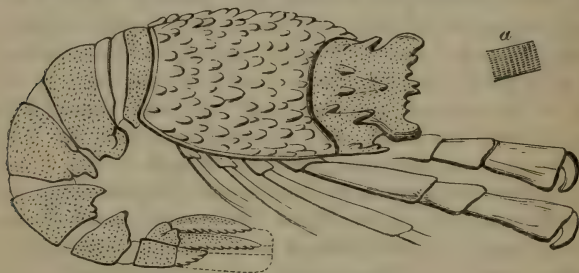


Diagram of *Archæocarabus*.

a. Portion of one of the outer antennæ.

tion depressed, front wide, subtruncate toothed, the lateral angles produced into large, flattened, slightly recurved spines over the eyes, shell below the orbits prolonged forwards into a thick spine ; *crust* excessively thin and fragile, covered with

coarse adpressed tubercles ; *abdomen* very thick, rounded, nearly twice the length of the carapace, segments nearly smooth, punctured, their extremities broadly falcate ; tail having the crustaceous portion at the outer margin of the base of the two outer pair of fins long, elliptical, strongly serrated on their inner edge.

In all the characters of generic importance which I have seen in these fossils, they approach the recent *Palinuri* or spiny lobsters, with the important exception of the structure of the first pair of feet, which in the recent genus are small, slender, and terminated by a simple point for walking only, forming a strong contrast with the present genus, in which they are powerful prehensile organs, much more robust than the other feet, broadly dilated towards the end, and terminated by a strong subcheliform claw. I only know the genus in the eocene tertiary strata.

Archæocarabus Bowerbanki (M'Coy).

Sp. Char. Carapace about 2 inches 4 lines long and 1 inch 9 lines wide, all behind the nuchal sulcus marked with large semioval flattened tubercles, their blunt apices directed forwards and encircled by a crescent of small pores ; the largest tubercles are about the middle of the back, and have a few small ones irregularly placed in the intervals, towards the side-margins they become smaller and more equal ; anterior or cephalic portion more nearly smooth, having only small, sharp, widely separated granules, one on each side of the middle near the base and one or two in the median line near the front much larger than the rest ; front margin with about three denticles on each side between the middle and the broad compressed horn-like processes at the angles, from each of which latter a ridge extends backwards bearing two or three strong spines ; the anterior prolongation of the cheeks beneath the orbit has also a row of a few large spines : *abdomen* to end of caudal fins nearly twice as long as the carapace, semicylindrical, nearly smooth, with few distant punctures, the ends of the first five segments abruptly narrowed, thickened and falcately curved backwards, sixth segment having articulated to each end the two thick, elliptical, crustaceous outer marginal supports of the two outer pair of tail-fins ; they are about three times longer than wide, serrated on the inner edge : *first pair of feet* larger than the others, compressed, penultimate joint dilated towards the extremity into a flattened trigonal hand ; *terminal joint* forming a strong, subcompressed, curved, moveable finger, as long as the truncated end of the preceding joint, to which it is opposed for prehension, the *arm* about as long as the *leg*

of the second pair; *carpus* about one-third the length of the arm and half the length of the hand, the width of which latter at top exceeds half its length; *three next pair of legs* compressed, gradually diminishing in size; fifth pair not seen. At about 2 inches from their bases the external antennæ are one-fourth of an inch in diameter.

I have great pleasure in dedicating this fine species to Mr. Bowerbank, who has done so much to illustrate the fossil botany and zoology of the London clay—his work on the former having almost created the subject; while the extraordinary extent and beauty of the collections which he has made of the other fossils of that formation are, I believe, quite unrivalled, and when fully published will demonstrate a richness in the fauna and flora of the eocene period in Britain for which few geologists are prepared. I have especially to record my obligations to him for sending me a large number of his choicest specimens of London-clay crustacea of those species which I informed him I was about describing from the Cambridge collection, but the specimens of which at my disposal did not fully exhibit all the characters of the species; and having mentioned my anxiety to render my descriptions of those as perfect as possible, without entering further on the extensive subject of the Crustacea of that formation.

The present species is usually found with the abdomen doubled close under the thorax, which latter is almost always crushed, owing to the fragile delicacy of the crust.

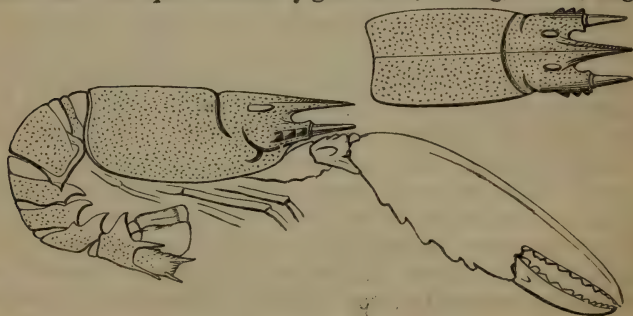
Rare in the London clay of Sheppey.

(Col. University of Cambridge and Mr. Bowerbank.)

Hoploparia (M'Coy), n. g.

Etym. ὄπλα, *arma*, and παρειά, *gena*.

Gen. Char. *Carapace* minutely granulose, oblong, tumid, slightly



Hoploparia.

compressed, a little deeper than wide, ending in front in a strong sharp rostrum, the sides of which are strongly carinate

and smooth, or with few very minute teeth ; beneath the orbits the cheeks are prolonged forwards about half the length of the rostrum, and usually strongly keeled and spinose, forming a semicylindrical sheath over the base of the strong triangular scale of the origin of the outer antennæ, which reaches as far as the rostrum ; *nuchal furrow* strongly marked across the middle of the back, but not reaching the marginal third of each side ; *cheeks** impressed by a deep λ -shaped sulcus, one portion of which extends upwards nearly parallel with the nuchal furrow, the longer lower branch curves forward under the projecting part of the cheeks, and the shorter branch curves backwards under the end of the nuchal furrow : *abdomen* subcylindrical, smooth or slightly punctured, the second joint having broad, dilated quadrate ends, the third, fourth, and fifth terminating in triangular or broadly falcate extremities, the sixth having articulated to each end the two outer pairs of large trigonal tail-fins, the outer one of which on each side is divided by a transverse suture rather less than one-third from the extremity ; seventh joint (or middle flap of the tail) oblong, sides denticulated, extremity narrower than the base, and bearing a small spine at each corner ; *first pair of legs* very long and thick, unequal, the larger claw with large blunt teeth, the more slender one with more numerous and equal smaller sharp teeth ; the other legs slender.

In the general characters, so far as I have been able to ascertain them, these crustaceans coincide with the living genus *Hemarus*, but are constantly distinguished by the sheath-like prolongation of the strongly ridged and spinose cheeks, the nearly smooth-sided rostrum, and the short distance which the nuchal furrow extends down the sides, as well as the separate λ -shaped cheek-furrow on each side, and the size of the antennary scale. There are several species common in the British eocene tertiary and cretaceous rocks, only one of which has yet been noticed, viz. the *Astacus longimanus* of G. Sowerby (Zoological Journal, vol. ii. tab. 17) from the greensand of Lyme Regis, which I find to belong to the present genus, and which should have the name *Hoploparia longimana* (Sow. sp.).

Hoploparia prismatica (M'Coy).

Sp. Char. *Carapace* (excluding the rostrum) $1\frac{1}{2}$ inch long, width 10 lines, subcylindrical behind, but having the section of a five-sided prism towards the front from the strong projection of the large, acutely angular cheek-ridges, which bear

* Or sides of the carapace immediately in front of each end of the nuchal furrow.

about three large sharp teeth each ; *rostrum* large, deeply channeled in the middle, sides rising to very prominent keels minutely serrated towards the end, one elongate tubercle on each side of its base ; *nuchal furrow* strong, ends curved forwards, but only extending about halfway from the middle of the back to the side margin ; beneath and in front of each of its ends a very deeply marked λ -shaped sulcus ; surface very closely and minutely granulated, punctured on the cardiac and intestinal region ; ends of the abdominal segments broadly rounded with a small mucronate point directed backwards ; the last two joints with rough transverse scale-like sculpturing, the others so finely granulated as to appear nearly smooth.

This species is remarkable for the size and prominence of its sharply angulated cheek-ridges ; the surface, particularly of the abdomen, is more nearly smooth than in the other species which I have seen.

Common in the Speeton clay of Speeton, Yorkshire.
(Col. University of Cambridge.)

Hoploparia gammaroides (M'Coy).

Sp. Char. *Carapace* averaging from the orbit to the posterior side-margin $2\frac{3}{4}$ inches, depth $1\frac{1}{2}$ inch, minutely punctured on the middle of the back, coarsely squamoso-punctate on the gastric region, granulated on the sides, most strongly near the front lateral margins ; *nuchal furrow* strong, but only reaching halfway down the sides, its middle portion equally distant from the edge of the orbit and posterior margin of the carapace, or slightly nearer the former ; λ -shaped cheek-furrow deep ; *rostrum* strongly bicarinate, with a ridge-like tubercle about two lines long on each side of its base, and one small tubercle at an equal distance below the first pair at the edge of the orbit ; from a little behind the level of the orbit the cheek is elevated into a strong keel with about three large spinose tubercles, cheeks prolonged as a semicylindrical sheath to the outer antennæ half the length of the rostrum : *abdominal segments* very flat and smooth, the articular anterior portion scarcely convex, and the sulcus dividing it from the posterior portion not very strong, first segment closely punctured like the middle of the thorax, the dorsal portion of the others with the puncta slight and distant, flaps of the tail coarsely squamoso-punctate ; *chelæ* very large, with a rude scale-like sculpturing of the surface, broad one having the hand as wide ($1\frac{1}{2}$ inch) as from the carpus to the base of the moveable finger, four large, short spines on the inner margin, moveable finger longer than from its base to the carpus ; *carpus* with several thick short spines ; smaller hand as long as

the great one, but about one-third less wide; other legs very slender (third and fourth pair about 3 lines wide), subcompressed, smooth.

This fine species much resembles our common recent lobster at first sight, and has as large or even more robust claws, but similarly armed: in by far the greater number of specimens the characteristic prolongation of the cheeks, with its spinose keel becoming fixed in the matrix, causes the entire front of the carapace from a little behind the rostrum to be broken off, and so leaving no trace of this part of the carapace, heightens the resemblance indicated by the specific name.

Common in the London clay of Sheppey.

(Col. University of Cambridge and Mr. Bowerbank.)

Hoploparia Belli (McCoy).

Sp. Char. Carapace averaging from the orbit to the posterior side margin $1\frac{1}{2}$ inch, depth of side 9 lines, closely punctured on the middle of the back, and very closely and uniformly granulated over the sides; *nuchal furrow* considerably nearer the posterior margin of the carapace than the edge of the orbit (measured a little one side of the mesial line), its ends reach two-thirds of the way from the mesial line to the lateral margin; λ -like cheek-furrow strong; sheath-like prolongation of the cheeks obtusely rounded, the margins and lateral angles much inflexed, about half the length of the rostrum, two or three obtuse, undefined nodulations on the rounded prominence which extends backwards from its contracted carinate end towards the cheek-furrow; bayonet-shaped antennary scale narrow, extending as far as the tip of the rostrum; one blunt tubercle about twice its diameter from the median line on each side of the base of the rostrum, and another similar one at an equal distance below it on each side: *abdomen* thick, each segment having a gently convex smooth anterior articular portion divided by a strong deep furrow from the rest, which is flattened and very closely and strongly punctured; epimeral extremities of the first joint rudimentary, of the second broad, subquadrate, rounded on the anterior and external edges, subtruncate behind, with the angle forming a short spine, third, fourth, fifth and sixth terminating in broad triangular plates, slightly falcate, the sixth rather longer than the preceding ones, and having the posterior lateral angles produced backwards into a small spine on each side of the base of the seventh joint or middle tail-flap, which latter is subquadrate, its length and the width of the base being equal, narrowing towards the end, which is rounded and terminates at each angle in a small sharp spine; side margins thickened, minutely dentated: *first*

pair of legs closely scabroso-punctate ; *chelæ* oval, very slender, about double the length of the carapace, not very unequal, greatest width about half the length from the base of the little finger to the carpus ; section subrhomboidal, outer angle obtusely carinated, smooth, sides obtusely rounded in the middle, inner edge with two rows of about four large spiniform tubercles arched forwards ; fingers about one-third longer than the base, equal, subcompressed, rounded, straight and of nearly equal width throughout, nearly smooth, with a raised line of very minute teeth on the inner edge ; *carpus* small, section oval, scarce half the length from its tip to the base of the moveable finger, finely punctured, and with a few strong spines ; *arm* compressed ; the other legs slender and nearly smooth (third and fourth pair 1 line in diameter).

This species is much more common in the London clay than the *H. gammaroides* (M'Coy), which it resembles, although only half the length ; it may be distinguished therefrom by the finer and more uniform granulation of the sides, the greater length of the *nuchal* furrow, and its being placed farther back towards the posterior margin ; the cheeks, instead of being strongly carinated and spined, are only obtusely rounded and nodulated ; the *chelæ* are more slender, and the segments of the abdomen differ in the present species, having the anterior smooth portion of each more convex and separated by a much deeper furrow from the posterior part, which in the *H. gammaroides* is closely punctate in the first segment only, the others being polished with comparatively slight distant puncta, while in the *H. Belli* the hinder parts of all the segments are equally rough with a coarse close-set punctuation.

I dedicate this species to Prof. Bell, from whose able pen we may one day expect an illustrated volume on all the crustacea of the London clay, for which I believe the most ample materials exist in metropolitan collections which will be at his disposal. Mr. Morris, in the preface to his Catalogue, mentions in the cabinet of Mr. Bowerbank alone, the perfectly astonishing number of twenty to thirty species from this formation. Upwards of a dozen beautifully perfect specimens of this species were most obligingly sent me by Mr. Wetherell, on our mutual friend Mr. Yates mentioning that I was about describing the species from the Cambridge specimens, but was very anxious to render my specific description complete by the inspection of more perfect specimens. Mr. Bowerbank also lent me charming specimens with the same object.

Common in the London clay of Sheppey, Hampstead, Bayswater, Primrose Hill, &c.

(*Col.* University of Cambridge, Mr. Bowerbank, Mr. Wetherell, &c.)

Enoploclytia (M'Coy), n. g.Etym. ἔνοπλος, *armatus*, and *Clytia*.

Gen. Char. Carapace fusiform, back rounded, sides convex, gently compressed, posterior end slightly narrowed and deeply

*Enoploclytia*.

notched for the insertion of the abdomen, much contracted anteriorly, the front extended into a long, sharp-pointed depressed rostrum, the sides of which are armed with three or four strong spines; one strong spine over the upper external angle of the orbit; *eyes* on short, thick peduncles; *nuchal furrow* strong, slightly arched backwards, the ends reaching each side margin at a point deeply notched by the abrupt narrowing of the margin from thence to the front; *branchial furrows* double, inclosing between them a narrow, pointed ridge on each side, which meets its opposite fellow at less than a right angle (each meets the midline of the back at an angle of about 40°) on a point of the back about halfway between the nuchal furrow and the posterior margin; *abdomen* (including the tail-fins) shorter than the carapace, segments very weak, slightly arched, their ends triangularly pointed (ends of the second one not dilated), sixth longer than the preceding ones, giving origin to the two broad, rotundato-trigonal pair of side-flaps of the tail, which are very large, thin, and undivided by transverse sutures; seventh segment (or middle tail-flap) subtrigonal, thicker than the others and tuberculated; *surface* of carapace, legs and chelæ covered with large spinose tubercles and intervening granules of very irregular size; *first pair of feet or chelæ* very large, subcompressed, fingers slender, with a row of large teeth on the inner edge, carpus very short, tumid, trigonal; *three next pair of legs* slender, compressed (? apparently terminated by a blunt, trigonal, simple claw); *fifth pair* not seen.

In the large, flattened, strongly toothed rostrum, rough spinose legs, the small size of the abdomen, with the general form of its little-arched, weak segments, and the undivided outer pair of tail laminae, this genus approaches the recent *Galathæa* more than any other recent group, differing in its peculiar branchial furrows and ridges, meeting at an angle on the middle of the back, &c. The long, dentated rostrum, large, rough, spinose tuberculation of the carapace and chelæ easily distinguish those large cretaceous species from the diminutive genera *Clytia* and *Glyphæa* of the oolitic rocks with which they have been hitherto confounded. The type of the genus is the *Astacus Leachii* (Mant.), to which at least the figures marked f. 1 & 4. t. 29 of the 'Geology of Sussex' refer (some of the other figures possibly belonging to the *E. brevimana*, McCoy). The *E. Leachii* is also well figured and described by Reuss in his 'Versteinerungen der böhm. Kreideformation,' and by Geinitz in his 'Char. der Schich. u. Pet. des sächsisch-böhmischen Kreidegebirges.' It is distinguished by the very long, straight, narrow fingers of the chelæ, which are nearly twice the length of the basal part of the hand, or from their base to the carpus, and set on their inner edge with a row of narrow cylindrical teeth their own length apart; the whole hand (or penultimate joint and moveable finger) nearly one-fourth longer than the carapace. A second species of large size and remarkable form occurs in the chalk of Burwell and at Maidstone, several specimens of which I saw in the astonishingly beautiful collection of chalk fossils belonging to the Rev. Mr. Image, near Bury St. Edmunds: the hand in this species is much compressed as well as the carpus and arm, and all covered with large scattered curved spinose tubercles (largest on the outer and inner edges of the hand, carpus and arm) with an intermediate smaller tuberculation; the basal part of the hand is subrhomboidal, slightly longer than its width; carpus small, its greatest length and width equal, proximal end only half the size of the distal end, abruptly formed by a deep sinus in the proximal half of the inner margin (like that of the right arm of the recent *Callianassa subterranea*); penultimate or immoveable finger straight, rapidly tapering to an obtuse point, its length only equaling that of the hand from the base of the finger to the carpus; moveable or last finger a little longer, not tapering so rapidly, and incurved at the apex, each finger with a row of blunt hemispherical tubercular teeth less than their diameter apart. Average length of moveable finger 2 inches 6 lines, from thence to the carpus 1 inch 9 lines, width at base of fingers 1 inch 9 lines, width of carpus 1 inch 1 line, width at distal end 1 inch 3 lines. I have affixed the name of *Enoploclytia Imagei* to this, the largest and most interesting of the mesozoic

Crustacea, to commemorate the zeal and taste of the amiable owner, whose exquisite collection of cretaceous fossils would, if more fully known, greatly increase our knowledge of the fossils of this period.

Enoploclytia brevimana (M'Coy).

Sp. Char. *Carapace* subcylindrical or slightly compressed, averaging $3\frac{1}{2}$ inches long and 1 inch 9 lines deep; *rostrum* strong, pointed, with three or four large pointed teeth on each side, margins of the orbits with strong spines; *surface* closely studded with small tubercles and large scattered spines; *hands* short ovate, length little more than the depth of one side of the carapace, length of the moveable finger about equal to, from its base to the carpus, and a little longer than the width of the hand; both fingers incurved at the tip and set on the inner edge with a row of blunt hemispherical teeth half their diameter apart; *carpus* subtrigonal, a little longer than wide; *arm* compressed, about one-third longer than wide; surface of hand and carpus with many large, curved, spinose tubercles, and an intermediate, close, smaller tuberculation; length of moveable finger 1 inch 1 line, from thence to carpus 11 lines, width of hand 1 inch.

The very short small ovate hands easily distinguish this species from the other two.

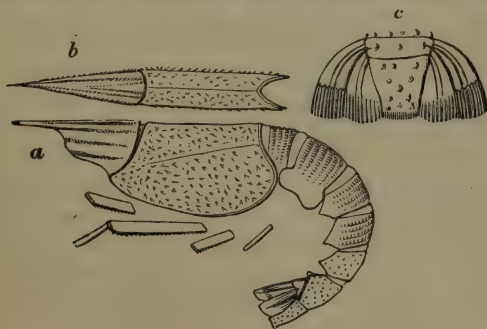
Common in the lower chalk of Cherry Hinton, near Cambridge.

(Col. University of Cambridge and Rev. T. Image.)

(Fam. *Thalassinidæ*.)

Meyeria (M'Coy), n. g.

Gen. Char. *Carapace* strongly compressed laterally; *nuchal furrow* very deep, V-shaped, the lateral portions nearly straight,



Meyeria.

a. Side view. b. Carapace seen from above. c. Tail-flaps.

meeting on the back at an acute angle considerably in front of the middle, and extending to the lateral margins at a point deeply notched by the abrupt narrowing of the front from thence to the sharp rostrum: *branchial furrow* forming a nearly straight, delicate, impressed line from near the lower ends of the nuchal furrow to the middle of each side of the posterior margin (never meeting on the midline of the back); portion in front of the nuchal furrow with a few longitudinal, strong, denticulated ridges, rest of carapace rough with small pointed granules: *abdomen* semicylindrical, large, segments sculptured with rows of granules, the ends of the second joint dilated, quadrate, of the others subtrigonal, penultimate joint a little longer than the fifth, carrying the two outer pair of *tail-flaps*, which are strong, truncato-elliptical, with a mesial ridge, ends fimbriated, the outer one on each side divided by a transverse serrated suture about one-third from the end; middle tail-flap oblong, apex truncated, narrower than the base; *legs* slender, compressed, smooth, gradually diminishing in size from the first, the lower edge minutely serrated.

The *Astacus ornatus* (Phil.) is the type of this genus, which, from the great compression of the carapace, size of the abdomen, character and direction of the branchial furrows, &c., seems to belong to the fossorial family in which I have placed it, the nearest analogue being perhaps the recent *Gebia* which burrows under the mud of Plymouth Sound: the fossils abounding in such a state of perfection in the fine Speeton clay that they must have lived in it and died in the exact spots we now find them, harmonizes with this view of approximating them to those similar little forms which live habitually buried in the mud. The substance of the crust, though very thin, and, in the following species especially, often showing signs of considerable flexibility, seems rather harder than in most of the fossorial types, and the strong fringe of stiff hairs at the end of the tail-pieces is in the fossil replaced by semi-membranous flaps, still however strongly sulcated. I have not seen the extremities of the feet; but if, as I suppose, the so-called *Crangon Magnevillii* of Deslongchamp (Mém. de la Soc. Lin. de Normandie, t. v.) belong to this genus, the four hinder pair of feet would terminate in simple pointed claws, and the first pair form subcheliform pincers, having the hand dilated and truncated at the extremity, which is toothed and has a small spiniform immoveable finger at one end, which is met by the slender moveable finger inflexed from the other end; this also agrees with the general type of the fossorial *Gebia*. The carapace may be distinguished from *Glyphæa* by the branchial furrow in it being very delicate and extending obliquely to the posterior margin without meeting its fellow of the opposite side,

while in *Glyphæa* they are very strong and meet on the back from opposite sides at an acute angle, without reaching the posterior margin.

Meyeria magna (M'Coy).

Sp. Char. Carapace about $2\frac{1}{2}$ inches long and 1 inch 2 lines deep at the middle of the side; three strong tuberculated longitudinal ridges on each side of the cephalic part of the carapace; from about the middle of the deep nuchal furrow a row of small tubercles extends halfway to the posterior margin, and higher up (bordering the intestinal region) a similar row on each side extends from the posterior margin nearly halfway to the nuchal furrow; rest of the carapace covered with minute sharp granules, about four in a space of three lines at the middle of the sides; *rostrum* short, pointed; *abdomen* about $3\frac{1}{2}$ inches long, each segment with about four irregular, single, crowded rows of granules disposed longitudinally, the broad intervening spaces nearly smooth; a few irregular groups of granules on the extremities; the last segment granulated like the carapace; *tail-flaps* broad, rotundato-trigonal, finely fimbriated at the ends, each with a strong mesial ridge; transverse suture of the outer pair strongly marked, serrated; *legs* subcompressed (section oval), smooth, the lower edge with a row of minute denticles directed forwards; third joint of the first pair nearly 4 lines wide, gradually decreasing to the fifth pair, the third joints of which are about 1 line wide.

Very abundant in the fine Fuller's earth of the "Lobster beds" of the lower greensand of Atherfield, Isle of Wight; also in the Speeton clay of Speeton, Yorkshire coast.

(Col. University of Cambridge.)

Note.—As the *Glyphæa rostrata* (Phil. sp.) (*Astacus rostratus*, id., Geol. York) has been referred by Herman von Meyer (Neue Gattungen fos. Krebse) and subsequent authors to the *G. Münsteri*, I may mention, that on comparing an authentic cast of that species with the English one, I find the latter fully distinguished, as a species, by the hind part of the thorax being much longer in proportion to the depth, even slightly exceeding in this respect the *G. pustulosa* (V. Mey.), which it exactly resembles in the character of its branchial furrows and their associated lobes, differing however from it and agreeing with the *G. Münsteri* in the abrupt notch-like narrowing of the margin in front of the nuchal furrow.

Ord. ENTOMOSTRACA.

(Trib. *Pæcilopoda*.)

This group being distinguished from other Entomostraca by having crustaceous, didactyle, ambulatory thoracic feet as well as

membranous, respiratory abdominal ones, is I think clearly the place for those remarkable genera, *Eurypterus* and *Pterygotus*; I cannot conceive why Dr. Burmeister should imagine the first of those genera to have no shell, and overlooking the didactyle structure of the larger crustaceous chelæ, &c., place it in his group *Palæadæ* (Dal.), which, as he observes (Organiz. Trilob., Ray ed. p. 53), might be united with the *Phyllopoda*. The figure and description given by Römer of the American species of *Eurypterus* in his paper in Dunker and Von Meyer's 'Beiträge zur Naturgeschichte der Vorwelt,' powerfully favour this view of approximating the genus to *Limulus*. With regard to the second genus, *Pterygotus*, M. Agassiz having renounced his original opinion of its being a fish, has, in his work on the Fishes of the Old Red Sandstone, referred it to the Entomostraca without indicating any particular division. Some years before the appearance of the 'Poissons fossiles des vieux grès rouge,' I had an opportunity of examining some much more perfect examples of this Crustacean than are there figured, which were brought before the Geological Society of Dublin by Dr. Scouler under the name *Lepidocaris* (from the scale-like sculpturing of the cephalic shield)*, and except the enormous difference in size, and perhaps a difference of superficial sculpturing, I see nothing in it different from *Eurypterus*; and when we bear in mind that the *Idothea* of Scouler† is avowedly a *Eurypterus*, I cannot see how *Pterygotus* is to be separated as a genus, at least on any better grounds than the above. The tribe *Pæcilopoda* might be resolved into two families: 1st, *Limulidæ*, having, besides the head, a second shield formed by the anchylosis of all the abdominal segments (*Limulus*); 2nd, *Eurypteridæ*, having all the abdominal segments distinctly separated (*Eurypterus*, *Pterygotus*, *Bellinurus*). The first division has not, I believe, been found lower than the oolites, the *Limuli* quoted by several British geologists from the coal-measures of Coalbrook Dale, &c. belonging clearly to the second division, and should rather be referred to *Bellinurus* of König.

Pterygotus leptodactylus (M'Coy).

Sp. Char. Large pincers having the hand about 5 lines wide, sculptured with fine short, irregularly flexuous, elevated lines; the penultimate or immoveable finger exceedingly slender, compressed, about 2 inches 10 lines long, and only 2 lines wide at base, gradually tapering to less than a line towards its obtuse point, nearly straight, or with a scarcely perceptible inward curvature; sides divided into ridges by three or four longitudinal furrows, thicker towards the back; last joint or moveable finger similar to the immoveable one, but rather

* See Dr. Apjohn's President's Address.

† See Edinb. Journal of Science, vol. iii.

smaller; inner edges of both fingers destitute of teeth or tubercles.

The pincers, instead of being excessively thick and strong, and armed with great teeth on the inner edge as in the *Pterygotus Anglicus* (Ag.), are perfectly unarmed, and so long and slender as possibly to indicate a separate subgenus, which might be named *Leptocheles* (λεπτός, *tenuis*, χηλή, *forceps*). It strikes me (judging from the figures) that the *Onchus Murchisoni* (Ag.) is not an Ichthyodorulite, but the long finger of the chelæ of this Crustacean,—the size, form and sculpturing agreeing very nearly—while the base presents no trace of the abrupt diminution for insertion into the flesh, which would occur in all true *Onchi*. In the same bed with the long chelæ was found a specimen of the terminal or moveable finger, and one perfect claw with both fingers *in situ* of a much shorter form than the other; the hand being about 3 lines wide, the penultimate immoveable finger about 1 inch long, and rapidly tapering from $2\frac{1}{2}$ lines wide at the base to the obtusely pointed apex; it is longitudinally sulcated like the longer one above described; the last joint or moveable finger is very different, being perfectly flat, triangular, 7 lines long, $1\frac{1}{2}$ line wide at base, and tapering rapidly to a point, the inner edge being straight and simple, the outer edge slightly convex. The hands of both kinds of chelæ are similarly sculptured with short, fine, sharp, irregularly curved, longitudinal plicæ, proving their identity, and that thus, like the recent *Pæcilopoda*, more than one pair of feet were didactyle.

In the fine olive schists (of the age of the Upper Ludlow rock) of Leintwardine.

(Col. University of Cambridge.)

(*New genera and species of Trilobites* *.)

Chasmops (M'Coy), n. g.

Etym. χάσμα, *hiatus*, and ὠψ, *oculus*.

Gen. Char. *Cephalic shield* subsemicircular, lateral angles produced backwards in triangular spines; *glabella* large, clavate, frontal portion very wide, transversely oval, only two distinct pairs of lateral segmental lobes, the anterior pair very large triangular, posterior pair small, middle pair obsolete or reduced to a minute tubercle on each side; neck-segment strong: *cheeks* small triangular: *eyes* small, rounded, "*hiant*," corre-



Cephalic shield of
Chasmops.

* See Annals of Nat. Hist. for December 1849 for some observations on the classification of Trilobites and the structure of their pleuræ, homologies of the cephalic shield, &c.

sponding in height to the middle portion of the first lateral lobe of the glabella; eye-line encircles the front of the glabella close to the margin, descends with an inward inclination to the eye, extending from behind the eye directly outwards to the lateral margin, which it cuts considerably in advance of the angles; *thorax* of eleven joints (*fid. Eichwald*); *pygidium* obtusely rounded, posterior margin deflected, anterior margin wider than the posterior; axis of about ten ribs, lateral ribs about two less, duplex.

The *Calymene Odini* of Eichwald may be looked upon as the type of this genus. It differs from *Calymene* in the glabella being so much wider in front than at the base, in the anterior lateral lobes being largest, in having but eleven (?) body-segments, and in its eye-line cutting the external margin in front of the angles, agreeing only in the structure of the eyes; these differences become agreements when compared with *Phacops*, from which it differs in the structure of the eyes. Of those organs in the present genus and in *Calymene* nothing is known beyond that they were of so tender and delicate a nature as readily to fall out after death, and are never found in the fossil state, their position being indicated by a hole, roughly filled by the matrix, forming the "hiant" eyes of systematists; in *Phacops*, on the contrary, the cornea is of extraordinary strength, and so firmly united to the rest of the cephalic shield, that no matter how much crushed the specimens may be, the eye always remains, and from its constant presence, coarse reticulation and large lenses, gives an appropriate name to the genus, and one which is in antagonism with that I have adopted for the present group: *Chasmops* differs besides from both those genera in the almost complete suppression of the middle pair of segmental lobes of the glabella.

Trimerocephalus (M'Coy).

Etym. *τριμερής*, *tripartitus*, and *κεφαλή*, *caput*.

Gen. Char. Elongate ovate: *cephalic shield* semicircular, with the lateral angles obtusely rounded: *glabella* very broad, gently convex, widely rounded and touching the margin in front; sides straight, converging to the narrow base; neck-furrow strong, and one fine, directly transverse, segmental furrow a little above it across the base of the glabella; *cheeks* smaller than the glabella, triangular, evenly convex, without eyes or facial sutures; *limb* almost wanting in front of the glabella, forming a narrow margin to the cheeks, and being rounded at the lateral angles forms the thick posterior margin of the shield and neck-segment; *thorax* of eleven joints, lateral lobes



Trimerocephalus.

wider than the axis, bent down at their margin; each of the axal segments with a strong tubercle at each end; *pleuræ* of equal width throughout, blunt at their ends, which are bent downwards and a little backwards, each marked along the middle by a pleural groove, angularly bent backwards about the middle, but not reaching the margin; trigonal facets small, narrow; *pygidium* small, obtusely rounded, entire, axal lobe distinctly rounded with about four or five segmental furrows; lateral lobes with about five flattened segments, each divided by a furrow.

This genus has been confounded by Count Münster, in his 'Beiträge zur Petrefactenkunde' for 1842 (only knowing the head), with *Trinucleus*, from which the structure of the body and tail, as well as the absence of the punctured border of the head, remove it very far; and it has been referred by Prof. Phillips (Palæozoic Fossils) to *Calymene*, from which the form of its cephalic shield and glabella, want of eyes and facial suture, and the different number of the body-segments, will I think sufficiently distinguish it.

I only know the genus in the Devonian rocks, the type being the *Trinucleus lævis* of Münster (*Calymene lævis*, Phil. Pal. Foss., not of Münster, whose *Calymene lævis* is a true *Portlockia*, M'Coy). It is perhaps most allied to *Ellipsocephalus* of Zenker, which has however twelve body-rings, eyes at the sides of the cheeks, a glabella pointed in front, and a little pygidium without segmental furrows.

Illænus latus (M'Coy).

Sp. Char. *Cephalic shield* more than twice as wide as long, moderately gibbous towards the base, but about one-half of the front arched over to a vertical position (or at right angles to the basal portion or plane of the body); *axal furrows* considerably less than half the length of the head, width of the included space, or glabella, equal to two-thirds the length of the head; *eyes* small, near the lateral angles, their own length in front of the posterior margin, two-thirds the width of the glabella distant from the axal furrows. Length of head 10 lines, width 1 inch 9 lines.

This is only likely to be confounded with the *I. crassicauda* (Dal.), from Gothland specimens of which it differs by the greater width of the head and less depth of the deflected front, and most remarkably by the very small size of the cheeks, resulting from the eyes being removed almost to the lateral angles; in the *I. crassicauda* they are only half the width of the glabella distant from the axal furrow, and the portion of the cheeks from the eye to the lateral angle is nearly one-third more than from the eye

to the axal furrow, while in the present species the cheek beyond the eye is little more than half the width of from thence to the sides of the glabella. Heads of the *Dysplanus centrotus* (Dal.) sp. differ in their much greater proportional length.

In the Lower Silurian limestone of Wray quarry, Upper Tweed. (Col. University of Cambridge.)

Isotelus affinis (M'Coy).

Ref. *Isot. gigas*, *I. planus*, and *I. Powisii* of Portk. Geol. Rep. (omit synonyms) t. 6. f. 1, and t. 9. f. 2 & 3.

Sp. Char. Axis of the body only slightly exceeding the pleuræ in width; *pleuræ* gently arched downwards at a very obtuse angle from about halfway between the axis and the extremity; a large pleural furrow reaches from the axis to about one-third of the truncated extremity of each; *pygidium* flattened, semi-elliptical, or slightly trigonal from the straightness of the sides; axis narrow, sharply defined, gently convex, reaching as far as the concave space round the margin.

In general proportions this resembles the *Isotelus gigas* (DeKay), from all the varieties of which it is distinguished, when specimens of the same size are compared, by the much greater flatness or depression of all its parts, the long, narrow, sharply defined axal lobe of the pygidium, and the much greater length of the pleural groove of the pleuræ (nearly double that of the *I. gigas*), as well as the distance of the knee from the axis, and slight degree of deflection of the pleuræ (being bent nearly at right angles at one-third from the axis in *I. gigas*). The pygidium differs from that of the *I. Powisii* (Murch. sp.) by the absence of all segmental furrows, except the first, on the lateral lobes, and by the more pointed outline and narrow margin.

Not uncommon in a Lower Silurian schist over the iron-works at Tremadoc; very similar in appearance to that at Pomeroy, co. Tyrone, which afforded the species to Col. Portlock.

(Col. University of Cambridge.)

Griffithides meso-tuberculatus (M'Coy).

Sp. Char. *Cephalothorax* 10 lines wide; *glabella* widely pyriform, broadly rounded in front, gently convex and narrowing posteriorly with concave sides, very minutely granulated, length 5 lines, width 4 lines; *cheeks* triangular, flat, smooth; *eyes* large, reniform, very minutely reticulated, with a large convex eye-lobe * connected with the base of the glabella by a small, oblique, oval nucleus; *limb* broad, convex, with nine or ten

* *Eye-lobe* seems preferable to *eye-lid* for the lobe covering the inner and upper aspect of the eye.

imbricating striæ, two-thirds concealed in front of the glabella, ending posteriorly in acute spines as long as the glabella; neck-segment broad; *pygidium* 6 lines long and $7\frac{1}{2}$ lines wide; axal lobe 2 lines wide, cylindrical, slightly tapering, of sixteen rings, each ornamented with about ten lengthened oval tubercles; lateral lobes depressed, of ten broad, flat divisions, each having a fine impressed line running close to its posterior margin, smooth to the naked eye, but with a strong glass one or two rows of minute crowded granules are seen; margin wide.

The axal lobe of the pygidium being strongly tuberculated and the lateral lobes nearly smooth, distinguish the species from all other carboniferous Trilobites I know of. It is allied to the *G. calcaratus* (M'Coy) and *G. longispinus* (Portk.).

Common in the shales of the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Cryphæus (Eccoptochile) Sedgwickii (M'Coy).

Sp. Char. *Cephalic shield* subsemicircular; *glabella* slightly clavate, smooth, three segmental furrows on each side, the posterior pair longest, turning backwards and inwards nearly to the neck-furrow, inclosing a triangular space on each side longer than wide, the width rather less than that of the undivided portion of the glabella between their bases, the two anterior pair of furrows shorter; *cheeks* broad, gently convex, closely and coarsely pitted: *thorax*, *axal lobe* very convex, narrow, slightly tapering, nearly parallel-sided, smooth, of twelve segments, three similar ones belong to the pygidium, the terminal one being obtusely trigonal; the side lobes are flattened, and more than double the width of the axal lobe; *pleuræ* nearly straight, narrow, and for the greater part of their length flattened, and having a broad, nearly mesial pleural sulcus deeply punctured like the cheeks, dividing each into two parts, the posterior largest and forming a thick, smooth, rounded ridge, bent down and a little backwards in the distal third of its length, swelling to a thick narrow ridge in the middle, the sides and extremity expanding into a broad, thin, foliaceous appendage; the pygidium terminates in six broad ovate, leaf-like, semimembranous flaps. Length of thorax and pygidium 2 inches 2 lines, width 2 inches 3 lines, width of axal lobe 6 lines.

This magnificent Trilobite can only be confounded with the *Eccoptochile clavigera* (Beyrich sp.), from which it is distinguished by the much greater width of the lateral lobes of the thorax, and the thin, flat, leaf-like appendages of the pygidium,

which in that species resemble thick pear-shaped clubs. A comparison with the old description and casts published by Green induces me to place this Trilobite in his little-known genus *Cryphæus*, and to doubt very much the propriety of separating *Eccoptochile* of Hawle and Corda from it, the only difference being the thickness of the marginal appendage in the Bohemian genus*.

The nearly entire specimen described was collected by Prof. Sedgwick from the Wenlock shale two miles north of Bulth.

(Col. University of Cambridge.)

Ceraurus octo-lobatus (M'Coy).

Sp. Char. *Pygidium* transversely elliptical, twice as wide as long, two first rings of the axis narrow, distinct, third or terminal one large, terminating in four flattened elliptically pointed lobes; two rather larger similar lobes on each side. Length $2\frac{1}{2}$ lines.

This curious little species differs from all of this and the allied genera in having the terminal segment of the pygidium quadri-lobate, so that the margin of the pygidium exhibits eight marginal pointed lobes in all.

It is figured in the 'Memoirs of the Geol. Survey' from Sholes Hook, under the same reference as the cephalic shields there called *Sphærexochus juvenis* (Salter) †, but not alluded to in the text.

In the limestone of Rhiwlas.

(Col. University of Cambridge.)

Ceraurus Williamsii (M'Coy).

Sp. Char. *Cephalothorax* semielliptical, length rather more than half the width; *glabella* semicylindrical, gibbous, rounded in front, with nearly parallel sides, three nearly equidistant, curved, segmental furrows on each side, the basal pair nearly confluent at their ends with the neck-furrow, inclosing a tumid ovate space on each side, separated by an undivided space about one-fourth of the width of the glabella; *thorax* twice the length of the glabella, axial segments large, two-thirds the width of the pleuræ, each of which has a very large, diagonally cleft, oblong tubercle at its origin, beyond which there is a neck-like contraction of the margin, followed at one-third from the axis by a hemispherical tubercle about half its diameter distant from the first, beyond which the distal two-

* Since this was printed, M. de Verneuil advised me to use *Eccoptochile* as the generic term for this Trilobite, as Green described two generic types under *Cryphæus*, and it is the second one which is best known under that name in America.

† Corrected to *S. clavifrons* (Dal.) in the list of plates prefixed to the same work.

thirds of each pleura is falciformly dilated into a thin, flat, fin-like appendage, the anterior margin of which is very convex, posterior margin slightly concave, extremity pointed; *pygidium* small, the six marginal spines small, all extending to about the same distance backwards, the anterior pairs therefore longest; they are thick, triangular, and three or four times wider than the others. Length of entire animal 1 inch 4 lines, of glabella 5 lines, width about 9 lines.

The disconnected, broadly falcate, paddle-shaped pleuræ help to distinguish this beautiful little species, which by its narrow elongate form resembles a *Remopleurides*. One entire specimen collected from the schists at Golen Goed, Myddfai, by Mr. Williams of Llandovery, and presented to Prof. Sedgwick by him.

(Col. University of Cambridge.)

Ogygia radians (M'Coy).

Sp. Char. *Pygidium* nearly semicircular, slightly convex; axis conical, undefined at the end, having three narrow segmental furrows at the anterior end, lateral lobes with three broad radiating ribs faintly divided at their axial ends by a small pleural furrow; margin tumid, entire. Length 4 lines, width 7 lines.

I provisionally give this name to a small pygidium not unlike that of the *Barrandia Cordai*, but, from the duplicate lateral furrows, belonging more probably to *Ogygia*; probably confirmatory of this view I observe in the 2nd Decade of the 'Geol. Surv.' t. 7. f. 5. a small eight-jointed true *Ogygia* from Builth, having the pygidium almost identical with the present species, if, as I suspect, the duplicating furrows have been accidentally omitted (the figure alluded to is given as the probable young of the *Ogygia dilatata* (Phil.), a trilobite which has not been found at Builth, but abounds in the schist at Waterford).

Not uncommon in the black Wenlock shale of Pen Cerrig, Builth.

(Col. University of Cambridge.)

Barrandia (M'Coy), n. g.

Gen. Char. Body ovate, depressed; *cephalic shield* semicircular, with the lateral angles produced backwards into short spines; *glabella* widely clavate, the axial furrow strong and nearly parallel at the base, becoming obsolete towards the front; *eyes* large, narrow, reniform; *eye-line* behind the eye cutting the posterior margin about the middle, in front of the eyes arching forwards, first outwards and then inwards; *thorax* of seven segments; *axis* convex, nearly as wide as the pleuræ,



Barrandia.

tapering towards the pygidium ; *pleura* flat, their ends slightly falcate and bent backwards, no facets, a slightly oblique submesial pleural furrow not quite reaching the end ; *pygidium* semicircular, entire, having very few simple segmental furrows placed near the anterior margin (one to three in number) ; *axis* short, having one to three small segmental furrows.

This I conceive to be a subgenus of *Ogygia*, from which it differs in its fewer thoracic segments, and having but very few and simple ribs to the tail. The genus agrees with the description given by Hawle and Corda of their genus *Alceste*, with the exception of this having seven thoracic rings and that having but four ; it is remarkable that *Alceste* is figured by those authors with three segmental furrows to the pygidium, while this has only one, making the *total* number of segments visible the same in both ; the number of the pygidial segments is however of course liable to vary with the species, while the thoracic ones are supposed to be constant. I know but one species, the following*.

Barrandia Cordai (M'Coy).

Sp. Char. Length one-fourth more than the width, length of head, thorax and pygidium almost equal ; *cephalic shield* slightly more than twice as wide as long, lateral angles very short ; *eyes* half their length from the axial furrow ; *pygidium* depressed, length rather more than half the width, axis two-thirds the length, conical, segmental furrows one on each side, obtuse. Length 11 lines.

Black Wenlock shale of Builth.

(Col. University of Cambridge.)

Ampyx latus (M'Coy).

Sp. Char. Entire animal transversely ovate, length one-fifth less than the width ; *cephalic shield* smooth, front margin regularly curved, width three-fifths the length ; *glabella* moderately tumid, pyriform, having a narrow vertically elongate (? ocular) swelling close to the middle third of each side, and two short,

* Since the above was written Mr. Salter has figured (2nd Decad. Geol. Surv. pl. 7. f. 4) a species of this genus, with three segments to the pygidium, which he gives without any apparent reason as the young of an Irish species of *Ogygia* (*O. dilatata*, Phil., *O. Portlocki*, Salt.). My reasons for dissenting from this view are, 1st, it is contrary to analogy of other allied Trilobites to suppose that the young and adult differ in the number of their thoracic segments ; 2nd, in the Cambridge collection, specimens of the *Ogygia Buchi*, half an inch wide, have exactly the same number of segments and other characters as an adult six inches long ; 3rd, the supposed young has only been found at Builth, where the Irish species, his supposed adult thereof, has never been found, being only known in the schists at Waterford, where it abounds, but where the supposed young have not occurred.

minute segmental furrows at each side of the narrow base ; *thoracic segments* five, pleuræ of each side twice the width of the axal lobe ; *pygidium* very obtusely and regularly rounded, four times wider than long, axis with about seventeen minute segmental furrows, sides with about eight. Length of entire animal $3\frac{1}{2}$ lines.

This rare species is most allied to the *A. parvulus* (Forb.) and the *A. nasutus* (Dal.), from both which the perfect animal is easily known by its transversely oval form ; the regular curvature and great width of the cephalic and pygidial shields easily distinguish those parts when found separate ; the latter agrees nearly in form with that of the *A. parvulus*, from which it differs equally with the former in all the other characters of cephalic shield, &c.

Rare in the black Wenlock shale three miles north of Builth. (Col. University of Cambridge.)

Tretaspis (M'Coy), n. g.

Gen. Char. General characters of *Trinucleus*, but having only five body-rings, the base of the glabella having two short segmental furrows at each side, and the cheeks being traversed diagonally by a nearly straight eye-line, extending on each side from the junction of the cheeks and glabella in front, towards the lateral angles cutting the posterior margin a little within the angles, and usually exhibiting a small ocular (?) tubercle in the middle. Types of the genus *Trinucleus seticornis* (His.) sp., *T. Bucklandi* (Bar.), &c.



Tretaspis.
Cephalic shield showing the eyes and diagonal facial sutures.

In my 'Synopsis of the Silurian Fossils of Ireland' I pointed out the course of the eye-line in this genus, which separates it at once from *Trinucleus*, and renders it probable that the small tubercle in the middle of the cheeks in the *T. seticornis*, *T. fimbriatus*, &c. are true eyes. The furrows at the base of the glabella also are distinctive for the genus*.

Trinucleus gibbifrons (M'Coy).

Sp. Char. *Cephalic shield* nearly semicircular, length rather more

* The statement of Mr. Salter (Mem. of the Geol. Surv. vol. ii. pt. 1. p. 335), speaking of Hawle and Corda's work, that "*Tetrapsellium* is distinguished from *Trinucleus* solely by a swelling in the axal furrow of the head ; it is almost identical else with *T. seticornis*"—might mislead the English reader with the idea that the present genus was identical with *Tetrapsellium* ; the fact is however, in his stricture on the Bohemian authors, Mr. Salter seems to have overlooked the grand character of their genus, namely its having but four body-rings ("vier Leibringe," H. & C. Monog. p. 42. 8th line) ; it agrees otherwise with the common type of *Trinucleus*.

than one-third of the width ; *glabella* pyriform, rounded in front, gradually narrowing towards the base, compressed, exceedingly gibbous, its height above the cheeks nearly equaling its width ; on each side of the neck-furrow (in casts) there is a deep puncture and another similar a little in front of it, a small spine on the middle of the neck-furrow ; *cheeks* spherical triangles, height and width about equal, moderately convex ; border of moderate width, three rows of punctures in front of the *glabella*, and five rows in front of the cheeks, more numerous at the sides, generally connected in front by radiating furrows, forming an imperfect fimbriation. Usual length of cephalic shield 3 lines. Surface very minutely granulated.

This very common species is figured without a name by Col. Portlock (Geol. Rep. pl. 1 B. f. 13 & 14). The fine granulation of the lobes of the head, and the extreme prominence of the gradually narrowing, pyriform, compressed *glabella*, separate this at once from either the *T. Caractaci* or *T. latus*, with which it seems to have been confounded ; it is wider than the former, less so than the latter. From the two little punctures on each side of the base of the *glabella*, this strongly approximates the *T. scyllarus* (His.) as distinguished from *T. seticornis* ; but although with abundance of specimens I cannot find an ocular tubercle or eye-line in the midst of the cheeks as in *Tretaspis*, to which those species belong ; those punctures indicate no doubt the existence of the muscles of the jaws and their appropriate rings, but are not extended into transverse segmental furrows as in those last-named species ; in the radiation of the border and number of rows of pores in front it approaches slightly the *T. radiatus* (Murch.), but is distinguished by the head being rounded, the cheeks wider, and the border not being more than half the depth, as well as being by no means so distinctly radiated.

Common in the lower Silurian limestone of Golden Grove ; the schists of Tre Gil ; and Caradoc sandstone of Alt y Anker, Meifod ; also at Pen y Craig. A variety with a shorter shield, the lobes of which are more spherical, perhaps from pressure, occurs in the black Wenlock shale three miles north of Builth.

(Col. University of Cambridge.)

Harpidella (M'Coy), n. g.

Gen. Char. Cephalic shield subtrigonal, surrounded by a thick, narrow, flattened border ; sides nearly vertical, compressed ; *cheeks* entirely surrounding the *glabella* in front, forming there a narrow tumid border, widening backwards as they descend into tumid, broad, triangular, nearly vertical wings, having large prominent eyes near the middle of their posterior mar-

gin, and from them on each side an obscure impressed line extends upwards and inwards to about the first third of the glabella (perhaps indicating the *eye-line*); *glabella* very convex, semielliptical, obtusely rounded in front, surrounded by a strong defining sulcus; two segmental furrows on each side, the first very strong, curving, from about the middle of the sides of the glabella, inwards and backwards into the neck-furrow, so as to include a large tumid ovate lobe on each side; a little above this, the very short and faintly marked anterior segmental furrow curves in the same direction; *surface* granulated. (Type of the genus *Harpes*? *megalops*, M'Coy, Syn. Sil. Fos. Irel. t. 4. f. 5.)

The head alone of this genus is known, which differs from *Harpes* (Gold.) in its small size, narrow unpunctured rim, absence of the ocular tubercle on the anterior part of the cheeks, great size and basal position of the eyes, &c.

(Fam. *Lymnadiadæ*.)

Ceratiocaris (M'Coy), n. g.

Etym. *κεράτιον*, *siliqua*, and *καρίς*, *squilla*.

Gen. Char. *Carapace* bivalve, the dorsal line simply angulated (? undivided), with a slight furrow beneath it on each side; sides semielliptical, much elongated from before backwards, evenly convex, ventral margin gently convex, posterior end abruptly truncated obliquely; on each side near the anterior end considerably below the hinge-line is an ocular (?) spot, sometimes raised and distinct, in some species flat; surface marked with fine, imbricated striæ, obliquely longitudinal.



Ceratiocaris.

a. The ocular spot.

In their pod-like form some of the species resemble such shells as *Solenocurtus* and *Solenimya*, except in the abrupt truncation of the posterior end; others resemble the Crustacean genus *Dithyrocaris*, with which I think their affinity lies, though they differ in form and want the peculiar ridges of that group. I conceive they were phyllopodous Crustaceans allied to *Lymnadia*; the peculiar texture and kind of lineation of the surface resemble what we find in Crustacea allied to *Apus* rather than in Mollusca; the general pod-like form, large size, and posterior truncation separate them from any of the large species of *Cythere* or *Cypridinia*, and the two ocular spots separate them from all others. I suspect from some of the specimens that the two sides meet along the dorsal line at an angle of 45° , with probably little

power of motion. The ocular spots even when flat may generally be recognized with care from the difference in their mineralization; they are often dark-coloured as if retaining some of their pigment, and have a slightly granular aspect, corresponding in fact very closely, both in position on the shell and in apparent structure, with the double-eyed *Cypridinia* of the Indian Ocean. In one species there is a short sulcus extending on each side from the medial line behind the eye obliquely backwards and outwards, reminding us of the perhaps somewhat similar nuchal furrow of *Apus*. I only know the genus in the upper Silurian rocks.

Ceratiocaris solenoides (M'Coy).

Sp. Char. Sides meeting along the back at an acute angle, each being nearly four times longer than wide, the ventral margin nearly straight and parallel with the dorsal line; anterior end narrowed and truncate obliquely forwards and outwards from the dorsal line; posterior end scarcely narrowed, truncated obliquely backwards and outwards; valves evenly convex, the edge slightly thickened; *ocular spot* a little depressed, close to about the middle of the truncated anterior margin; from the internal (dorsal) anterior angles a small furrow extends a little way obliquely backwards and outwards; oblique longitudinal striæ very close and fine; *eyes* two-thirds of a line in diameter; width of each side from dorsal to opposite margin $5\frac{1}{2}$ lines.

This much resembles a little *Solen* in form. The ocular spot is generally dark-coloured.

Common in the Upper Ludlow rock of Benson Knot.

(*Col.* University of Cambridge.)

Ceratiocaris ellipticus (M'Coy).

Sp. Char. Each side longitudinally elliptical, evenly convex, about twice and a half longer than wide, greatest width of the side and curvature of the margin about one-third from the anterior end, which is elliptically pointed; posterior end obtusely rounded, the oblique truncation nearly effaced; ventral margin convex; ocular spot elevated like a small tubercle, twice its diameter from the dorsal line, and about one-fourth the length from the anterior end; I believe the striæ of the surface have the direction usual in the genus, but they are very delicate. Length 1 inch 3 lines, greatest width of the sides 6 lines.

The elliptical form, prominence of the eye-spot, and its distance from the anterior end, mark the species well.

Rare in the Upper Ludlow rock of Benson Knot.

(*Col.* University of Cambridge.)

Cytheropsis (M'Coy).

Syn. *Cytherina* (Burm., not of Lamarck).

I provisionally propose this name for the little bean-shaped bivalve Entomostraca of the palæozoic rocks, which were formerly referred by myself and others to *Cythere*, but which Dr. Burmeister suggests should rather be referred to the *Phyllopoda*. As apparently the same forms of carapace exist both in the *Phyllopoda* and *Lophyropoda*, it is clearly more logical to refer those fossils to the former group, which we believe to have abounded at the palæozoic period, than, by placing them with the analogous types of the *Lophyropoda*, to quote the occurrence of that tribe at those early periods without sufficient reason.

In M. Bosquet's memoir on the Entomostraca of the Maëstricht Chalk, he proposes to refer all the ornamented species which I have described and figured in my Synopsis of the Mountain Limestone Fossils of Ireland, to the recent genus *Cypridina*; this I suppose is on the supposition that the tubercles represent the lateral eyes of that genus; but though the eyes were possibly lateral also in the fossil group, there is no evidence of the fact, nor reason for supposing they were not similarly placed in the plain ones; I therefore think the plain and ornamented species should not be divided, and for the above reason think they are both better placed with the Phyllopodes. It is singular that Prof. Burmeister, in establishing this genus and stating that the palæozoic limestones contained the only representatives of it, should have applied to them the Lamarckian name *Cytherina*, which is a mere *double emploi* of Latreille's recent genus *Cythere*. The carboniferous genus *Bairdia* (M'Coy) is distinguished from the above by its attenuated recurved extremities.

CHAPTER VII.*

SILURIAN RADIATA.

ZOOPHYTA.

Fam. GRAPTOLITIDÆ (M'Coy).

STEM simple or branched, thin, usually linear, horny, unrooted; polype-cells sessile in one or two rows; each cell divided at bottom by a transverse diaphragm.

In the form of the thin horny polypidom and polype-cells the *Graptolitidæ* agree with the *Sertulariadæ*, but differ in not being rooted. I have never found any trace of ovarian vesicles; others may find them, however, by examining great numbers of specimens, or by some fortunate accident; or, like the closely allied *Corymorpha* (which agrees with the *Graptolites* in having a free polypidom), the ova may have been developed in naked sacs attached to the base of the tentacles of the polypes, and would not leave any trace in the fossil state.

On the same grounds that the allied recent genera *Plumularia* and *Sertularia* are separated, I propose to restrict the term *Graptolites* to those which, like the original typical species, have the cell-denticles only on one side, and for those having them on both sides I propose the generic name *Diplograpsus*. Prof. Nilsson and Col. Portlock have published nearly similar views, the latter with great clearness.

Graptolites lobiferus (M'Coy).

Sp. Char. Several inches long, straight; axis capillary, undivided portion of the stem about one-third of a line wide; cells forming large, obtusely rounded lobes, uniformly convex on the upper and outer margin; a notch on the outer edge separates the rounded extremity from the oblique descending margin; four cell-lobes in 3 lines; width from axis to end of cell-lobe slightly less than 1 line.

The rounded lobe-like form of the cells and their size render this one of the most distinctly marked species of the genus. Fragments are often beautifully iridescent.

Common in the black shale of Lockerby.

(Col. University of Cambridge.)

* The species in this chapter date from the 'Annals' for October 1850, except *Strephodes trochiformis*, *S. pseudo-ceratites*, *Cænites strigatus* and *Palæopora subtilis* from the Number for December 1850.

Graptolites millipeda (M'Coy).

Sp. Char. Length unknown : occurs in short, curved or spirally inrolled fragments ; cell-denticles on the outer side, each broad at the base and abruptly contracted to a small mucro, deflected or strongly curved backwards, both the upper and lower margins being sigmoidally curved ; the denticles touch each other (when fully preserved) at their bases ; five or six denticles in the space of 2 lines ; width from axis to end of cell-denticles slightly more than half a line.

The much closer, shorter and wider cell-denticles with their abruptly recurved points, easily separate this species from the *G. convolutus* (His.), the inrolled form of which agrees with it. I only provisionally characterize the species, as there is a possibility that if the *G. convolutus* be only the top of *G. Sedgwickii*, this might ultimately form the corresponding portion of the *G. lobiferus*, a supposition which at present however is not supported by any evidence, there not being the same amount of resemblance between the two latter as between the two former species, the difference in size and structure of the cells being much greater.

Not uncommon in the black shale of Lockerby.

(Col. University of Cambridge.)

Diplograpsus rectangularis (M'Coy).

Sp. Char. Straight, simple, usually from 1 to $1\frac{1}{2}$ inch long, 1 line wide, gradually tapering to the base, which is a fine simple point ; axis fine capillary ; cells perfectly at right angles to the axis, forming square denticles to the margin, distinctly separated by rather wide parallel-sided notches reaching two-thirds of the way to the axis, five in the space of 2 lines.

This species is more distinct and constant in its characters than most of the allied forms ; in general appearance it approaches the *D. pristis* (His. sp.), but is easily distinguished by the short square cells, *set at right angles to the axis*, instead of the narrow very oblique ones of that species. The only Graptolite making any approach in the form and direction of the denticles is the *bicornis* of Hall, which however is distinguished by the strong lunate process to the base, from which it derives its name ; the base of the present species being a simple point as in the *D. pristis* ; there is also in most of Mrs. Hall's figures a perceptible obliquity in the denticles, which so admirable an artist could not have designed for this species : the bicarinate base (so commonly preserved in the *D. bicornis*) certainly does not appear in ours. Both this and the *D. pristis* being of considerable thickness are occasionally liable to be compressed in a plane at right angles to that usually seen, the two rows of cells being pressed flat against

each other, and so producing the form figured and described by Hisinger, Portlock, Hall, &c. under the name of *Graptolites scalaris*; and as the numerous specimens under my examination show every stage of the accident, I do not hesitate to recommend the suppression of that species.

Abounding in the black shale of Lockerby.

(Col. University of Cambridge.)

Fam. GORGONIADÆ.

To this family I provisionally refer the two following new genera, from the relations of their nearest living analogues.

Protovirgularia (M'Coy), n. g.

Etym. *πρῶτος*, *primus*, and *virgularia*.

Gen. Char. Stem capillary, dichotomously branching, closely set on each side with short, alternately placed pinnules, either contracted close up to the axis in a doubly oblique alternating series, or extended with a gentle upward and outward curve, each pinnule transversely ridged with about five parallel cylindrical cells placed at right angles to its length.

This is a most interesting type, as in the form of its axis and the structure of the transversely ridged celluliferous pinnæ, both in the curved extended, and in the straight contracted states, it perfectly resembles the recent *Virgularia mirabilis*, while by its branching it approximates to the *Hydroïda*, thus completing the passage between that great group and the eight-rayed corals by the present genus on the one hand and the free *Hydroid Graptolites* on the other. I know but one species which resembles at first sight the *Graptolites ramosus* of Hall, but that species has only simple denticles, on one side of the branches, while this differs from it and all other *Graptolites* by its two alternating rows of moveable pinnules, transversely furrowed, apparently to contain each a number of polypes, as in the recent group to which I have approximated it. I have little doubt the so-called *Graptolites amplexicaule* figured by Hall (t. 26. f. 11) may ultimately be referred to the same group, though the characteristic cell-furrows at right angles to the upper edge of the pinnules have not yet been noticed.

(Col. University of Cambridge.)

Protovirgularia dichotoma (M'Coy).

One specimen about $2\frac{1}{2}$ inches long, branching twice at an angle of about 30° , and shows all the pinnules extended at right angles to the capillary axis with a gentle upward curvature like

the living *Virgularia* in the same state; another simple fragment about the same length has them half-expanded, being nearly straight and oblique to the axis; a third fragment has them quite contracted, resembling a bit of narrow braid, exactly like the contracted state of the recent *Virgularia mirabilis*; this one shows very plainly the transverse cell-ridging, rather less than 1 line wide; four pinnæ in the space of 2 lines.

In the slate at Lockerby.

(Col. University of Cambridge.)

Pyritonema fasciculus (M'Coy).

I propose the above name for a singular fragment of a fossil from the dark limestone of Tre Gil, nearly straight, about $2\frac{1}{2}$ inches long, 4 lines wide, and $1\frac{1}{2}$ line thick, and marked longitudinally with coarse, thread-like ridges about the third of a line in diameter, occasionally cut by small sharp transverse wrinkles, the whole having some resemblance to an *Ichthyodorulite* (*Onchus* or *Ctenacanthus*), with which I believe it was confounded by previous observers. On first seeing the specimen, I doubted this reference, from observing that the ridges, instead of being merely superficial, thicker and more numerous at one end, as they should be on this view, seemed equally thick at each end, and clearly not in one plane, but those at the surface of one part plunging into the mass and giving place to others emerging from it. Owing to the skill and kindness of Mr. Anthony, of Caius College, two sections for the microscope were prepared, which proved that the whole mass was really a bundle of thread-like rods of silica, corresponding exactly in diameter with the external ridges, the sections of which exactly correspond with the others in the interior; the siliceous fibres are solid, cylindrical, with slight occasional transverse rugosities; they are less than their own diameter apart; and the interstices show no organization under a magnifying power of 330 diameters, the limestone being of a finer texture and lighter colour than that of the matrix, as if there had been originally a soft animal matter in the spaces between, which kept out the coarser calcareous mud, but which became filled with finer material by percolation on its decomposition. I am therefore rather inclined to compare the fossil in question with the *Hyalonema* of Gray, of which a short notice was published in the Geol. Proceedings 1835, being, according to that naturalist, a recent marine zoophyte allied to *Gorgonia*, called "Glass plant" by the English at Canton. It has a long, thick, rope-like axis, formed of a bundle of very long slightly twisted threads of pure silica, held together by a little animal matter, the whole having an external animal pulpy layer in which the polypes were lodged, and which falls away at their death, leaving the siliceous axis of

glass-like fibres exposed*. The analogy between those seems to me very strong, and I know of nothing else in nature like the fossil. I have named the genus from *πυρίτης*, *silex*, and *νήμα*, *filum*. Lest the specimen might be supposed to resemble a bundle of certain *Serpulae*, I may mention that the rods of silica are not tubes, and have no walls.

Strombodes Wenlockensis (M'Coy).

Sp. Char. Corallum forming large irregular masses of polygonal stems, the mouths of which vary usually from 8 to 10 lines in diameter; boundary-walls strong, prominent, vertically sulcated on the inside; star depressed round the margin of the walls, forming a large circular convexity nearer the centre, within which is a concavity, from which rises the thick prominent compound axis; radiating lamellæ twenty-four to twenty-nine, strongest and most prominent on the circular convexity of the star, where an equal number of small alternate ones disappear: *vertical section* shows the thick central axis composed of irregularly twisted plates, inner area a little narrower than the outer area, from which it is separated by a solid vertical wall, crossed by loose vesicular structure curving upwards and outwards, one or rarely two vesicular plates reaching across the area on each side, vesicular plates of the outer area more curved, slightly smaller, the rows inclining slightly upward and outward, scarcely three cells in a row. A star 9 lines in diameter has the prominent circular portion 7 lines in diameter, and the prominent axis rather more than 1 line in diameter.

To judge from the figure in the 'Silurian System,' that marked t. 16. f. 8 *a* (not the 8 *b*), of Mr. Lonsdale's *Acervularia Baltica* (Schw.), would seem to belong to this species, but according to Phillips that has far more than thirty-six lamellæ (Pal. Foss.); the species represented by the latter figure has neither axis nor divisional walls to the stars, and is certainly generically distinct from *Strombodes*; the true *A. Baltica* of Schweigger, according to his reference to the 'Amœnitates Academicæ,' has no axis and cannot belong to the present genus, of which this species is the only one I am acquainted with in Silurian strata. The fracture as usual passes through, and not between the columns, and the buds are developed in the corners of the old stars.

Not uncommon in the Wenlock limestone near Wenlock.

(Col. University of Cambridge.)

* I believe M. Edwards considers this recent form to belong to the *Amorphozoa*, and that the observed polypes were parasites. From the axis of *Antipathes* being siliceous, I adopt for the present Mr. Gray's opinion.

Strophodes Craigensis (M'Coy).

Sp. Char. Corallum forming irregular, slightly flexuous, slowly tapering, obscurely nodulose subcylindrical stems, averaging 7 or 8 lines in diameter when old, but both at that size and at 3 to 4 lines in diameter, tapering at the rate of 1 line in 1 inch; outer wall thick, marked with longitudinal fine lamellar sulci (ten in 3 lines); terminal cup shallow, lined by the radiating lamellæ, which are strongest a little within the circumference, and are obscurely complicated at the centre; connected at the sides by distinct transverse vesicular plates: *horizontal section*, outer solid wall thick, sixty-five to sixty-eight slightly flexuous, radiating lamellæ, one half of which extend about half-way to the centre, the other half slightly thickening, uniting in groups of two or three and complicated at the centre; transverse vesicular plates few, most numerous towards the circumference: *vertical section* shows a thick external wall on each side, from which rows of depressed elongated irregular cells curve gradually under the centre, the plates being thickest and nearly horizontal in the middle half of the diameter.

In the greater thickness, size, and approximately horizontal disposition of the vesicular plates in the middle of the corallum, there is an approach to *Cyathophyllum*, but in the cup and horizontal section the radiating lamellæ are clearly seen to unite in bundles and reach the centre—characters totally at variance with those of *Cyathophyllum*. On some of the slender stems obscure signs apparently of lateral buds appear, but I cannot be certain of their true nature. It tapers more slowly than any other species I know.

Common in the limestone of Craig Head.

(*Col.* University of Cambridge.)

Strophodes pseudo-ceratites (M'Coy).

Sp. Char. Corallum small, simple, curved, conical, obscurely wrinkled concentrically; ordinary specimens about 1 inch 3 lines long, and 9 lines in diameter at that distance from the apex, rarely exceeding that diameter, though occasionally longer; outer wall with faint vertical lamellar sulci, nine in 3 lines, at 9 lines in diameter, or about sixty-five all round: *horizontal section* shows a dense, nearly solid, outer area less than one-third the diameter of the tube, in which the radiating lamellæ and the excessively close fine vesicular connecting plates are obscure; an inner circular area about half the diameter, into which only thirty-two to thirty-four (or each alternate one) of the radiating lamellæ penetrate, uniting irregularly and slightly twisted about the centre, connected by very

few, thin, vesicular plates: *vertical section*, the nearly solid outer area as above (about half an inch of the apex often also filled with solid matter), inner area traversed by numerous depressed small irregular cells, arranged almost horizontally, or with a slight upward curvature.

This species almost exactly resembles the small variety of the Devonian *Cyathophyllum ceratites* of Goldfuss (which I also find to be a *Strephodes*, thus differing from his larger variety to which I restrict his name), but is readily separated by its closer and more numerous lamellæ (that having only thirty-seven lamellæ at the above diameter). The *Streptoplasma corniculum* (Hall), from the Trenton limestone, is still more closely allied, but as it is impossible to be certain of the species of those turbinated corals without knowing their internal structure, I cannot venture to unite our British species, which I have worked out, with the American one, in which that has yet to be done, and of which I have no specimens to do it.

Common in the limestone of Old Radnor, Presteign, Radnorshire; Wenlock limestone of Dudley, Staffordshire and Sedgley. (Col. University of Cambridge.)

Strephodes trochiformis (M'Coy).

Sp. Char. Corallum simple, slightly curved, widely turbinate, average length 1 inch 3 lines, and width at mouth 1 inch 1 line, with irregular swellings of growth; outer wall very thin, marked with equal lamellar sulci (six in 3 lines at $1\frac{1}{4}$ inch in diameter, or eighty-three all round); terminal cup very deep, conical, margin rounded, sides gradually sloping, lined by the thin, alternately longer and shorter uneven-edged lamellæ, the longest of which are irregularly blended at the centre, connected throughout by numerous curved transverse vesicular plates: *horizontal section* shows the same characters as the terminal cup, the alternate lamellæ extending about half way to the centre: *vertical section*, apex filled with solid matter, centre with irregular vermicular lines (the sections of the complicated edges of the radiating lamellæ), from thence to the walls made up of small, thick, rounded, vesicular plates, the obscure rows having a slight downward curve.

One worn specimen from Dudley, in the collection of Count Münster, was considered by him and Dr. Goldfuss to be a variety of the *Cyathophyllum dianthus* (Goldf.) of the Devonian rocks, from which I find it differs generically.

Not uncommon in the Wenlock limestone of Dudley, Staffordshire.

(Col. University of Cambridge.)

Strephodes vermiculoides (M'Coy).

Sp. Char. Corallum of closely grouped, round columns of exceedingly irregular diameter from frequent intermittence of growth, producing very unequal annular swellings and funnel-shaped rings; external wall thin, marked by lamellar sulci (six in 3 lines at a diameter of 1 inch, or about twenty all round, indistinct at the more usual diameter of 8 or 9 lines); cup deep, lined with alternating large and smaller vertical lamellæ irregularly uniting about the centre, their edges and sides papillose and perforated, the union of which papillæ forms a dense broad granular margin to the cup obscuring the lamellæ: *horizontal section*, about twenty slightly and irregularly curved, flexuous, radiating lamellæ, extremely thin, indistinct and equal in the dense, nearly solid or granular outer area, where they are connected by very close, minute, curved, vesicular plates; one half of the lamellæ scarcely extend beyond the outer zone, the other half suddenly increase in thickness and proceed towards the centre, where they are irregularly united, connected by few large, curved, vesicular plates, forming nearly transverse rows of irregular cells: *vertical section*, outer third on each side very dense, of extremely small rounded vesicular plates nearly united, inner half of diameter composed of much larger, thin, irregular vesicular plates.

This coral may be distinguished from the *Cystiphyllum cylindricum* (Lonsd.) by the distinct radiating lamellæ towards the centre, and the small size of the vesicular structure towards the circumference, forming an almost solid white granular structure. The Devonian *Cyathophyllum vermiculare* of Goldfuss (also a *Strephodes*) is almost identical in external appearance, but has the radiating lamellæ thickest in the outer area, straighter and alternately of very unequal thickness, and wants the remarkable dense, almost unradiated outer zone. The lamellæ as usual are less numerous in young tubes of smaller diameter.

As far as I can judge from the figure alone, I should think the coral figured by Lonsdale as the *Cyathophyllum cæspitosum* of Goldfuss (S. S. t. 16. f. 10) from the Wenlock rocks might be probably referred to this species, which, in general size, form and mode of grouping of the branches, it resembles; it is quite certain that it has no relation to the true Eifel species of Goldfuss, which is common in the Devonian limestone of Newton Bushel, Torquay, Plymouth, &c., which has slender, even, dichotomous branches and broad transverse diaphragms, &c.

Wenlock limestone of Wenlock and near Aymestry.

(Col. University of Cambridge.)

Cystiphyllum brevilamellatum (M'Coy).

Sp. Char. Corallum elongate, subcylindrical, preserving for several inches a diameter of little more than an inch, slightly tortuous, and with obscure, irregular swellings of intermittent growth; outer wall extremely thin, strongly ribbed with alternately larger and smaller vertical lamellar sulci, about four large and three smaller in the space of 3 lines, at the diameter of 1 inch (or eighty-four all round); terminal cup with a circular depressed centre, equaling rather less than half the diameter, surrounded by an inclined outer area composed of twenty-four radiating lamellæ (corresponding to the stronger external sulci) extending from the walls about one-fifth of the diameter, connected by close numerous transverse vesicular plates, having at the margin an equal number of extremely short lamellæ (corresponding with the smaller external ridges); internal area broad, formed of large vesicular plates irregularly arranged: *vertical section* composed of arched, irregular, vesicular plates, curving gradually from the walls under the centre, small and numerous at the sides, considerably larger in the middle.

It is possible that Mr. Lonsdale's second figure of *Cystiphyllum Siluriense*, t. 16 bis, f. 2, may be a young group of this species, as this figure by its narrow form, radiated cups, &c. seems totally distinct from his fig. 1, which is the true type of his species;—a new specific name would be required for it in any case.

Wenlock limestone of Wenlock.

(Col. University of Cambridge.)

Caninia lata (M'Coy).

Sp. Char. Young corallum very widely conic, attaining the adult diameter of 3 inches at a height of about 2 inches, after which it remains cylindrical for a height of several inches, marked with irregular concentric obtuse undulations and small fimbriated lines of growth; in the young the radiating lamellæ are alternately longer and shorter, but before reaching the adult diameter, they are all thin and nearly equal, four or five in a space of 3 lines at a diameter of 2 inches 9 lines (or 110 to 116 all round), connected by numerous transverse curved vesicular plates; inner area formed of broad horizontal simple diaphragms, which at a diameter of an inch extend almost across the corallum to the exclusion of the outer vesicular and radiated layer; at a diameter of $2\frac{1}{2}$ to 3 inches they maintain a diameter of about an inch, the outer lamellated and vesicular zone having proportionately increased; each of the diaphragms is strongly bent downwards at one point of the circumference,

forming a distinct siphon ; outer wall extremely thin, forming a few root-like tubercles on the conical young ; terminal cup with a depressed flattened centre and very convex outer area.

In the Wenlock limestone of Wenlock.

(Col. University of Cambridge.)

Clisiophyllum vortex (M'Coy).

Sp. Char. Corallum simple, conic, slightly curved, enlarging at the rate of 1 inch 8 lines in 3 inches from the apex ; outer wall thin, faintly marked with subequal longitudinal lamellar striæ (five or six in the space of 3 lines at a diameter of 1 inch) and small concentric wrinkles ; at a diameter of 1 inch the horizontal section shows an outer area of about sixty thick, equal, radiating lamellæ barely reaching one-fourth of the diameter towards the centre, connected by small irregular transverse vesicular plates ; a few of the pairs have a very thin, short, marginal lamella between each of the larger ones, and where this occurs, the vesicular transverse plates become much more numerous ; inner area rather more than half the diameter, forming a circular mass of confused vesicular tissue crossed by a few arched radiating delicate lamellæ : *vertical section* having the narrow outer area on each side (corresponding to the lamelliferous zone) of arched vesicular plates, forming large unequal horizontal or slightly inclined cells, one or two extending across the width of the area ; wide inner area composed of small oval cells arranged in much-curved transverse rows, the convexity of the curve upwards.

Wenlock limestone, Wenlock.

(Col. University of Cambridge.)

Arachnophyllum typus (M'Coy).

Syn. & Ref. *Acervularia Baltica* (Schw.), Lonsd. pars S. S. t. 16. f. 8 a (not of Schweigger).

Sp. Char. Corallum forming thick, irregular, enveloping masses ; upper surface undulated, covered with large shallow polygonal stars, defined by very obtusely angular ridges ; the centres averaging 7 or 8 lines apart, circular, depressed, rather more than one-third the diameter of the star, radiated with about thirty-eight strong granulose subalternate lamellæ, half of which reach the flattened centre, where they are irregularly united and slightly twisted ; on the outer inclined area of each star, each of the lamellæ becomes much thinner and more faintly marked, branching di- or tri-chotomously once or twice, and often waving in a variable manner before reaching the

boundary, over which they frequently pass into the adjoining stars: *vertical section* showing a few delicate vertical striæ under the centres of the stars (edges of the twisted vertical lamellæ), and a nearly uniform small vesicular tissue, the cells of irregularly unequal size, passing from star to star, with a few irregular dense bands nearly coinciding in curvature with the form of the cells; average of larger cells two to three in 1 line; no divisional walls between the stars.

That this is *one* of the fossils figured by Mr. Lonsdale in the 'Silurian System' as the *Acervularia Baltica* of Schweigger I have little doubt, but neither the particular figure to which I refer, nor the others which that writer has given under the same name in that work, have any specific relation to the *Acervularia Baltica* of Schweigger, who avows that name to be only a synonym of the *A. ananas* (Linn. sp.), referring to the original figure, &c. in the 'Amœnitates Academicæ' of Linnæus, representing a coral which has a distinct-walled, tubular, centre, from which the groups of young are developed, solid walls between the cells, &c. The lateral disk buds are often seen in this curious coral.

Wenlock limestone near Aymestry.
(Col. University of Cambridge.)

Petraia æquisulcata (M'Coy).

Sp. Char. Conical, slightly curved, oblique, with a few broad, obtuse, undefined concentric swellings of growth; regularly increasing from the apex to a diameter of $1\frac{1}{2}$ inch at $2\frac{1}{2}$ inches from the base; external wall very thin, it and the cast regularly marked with equal obtuse ribs, about eighty-five in the adult diameter of $1\frac{1}{2}$ inch (six in 3 lines), eighty at 1 inch (eight in 3 lines), seventy-five at 9 lines and forty-six at 4 or 5 lines (ten in 3 lines), separated by thin, equal, equidistant slits representing lamellæ, each alternate one of which is merely marginal, the others occasionally and regularly uniting before reaching the centre, round which they are twisted to form a spirally conical central area; no connecting vesicular plates.

The regularity and equality of size of the lamellar ribs both on the exterior and on the cast, as well as their large number, give a peculiar aspect to this species. In parts of some specimens the lamellar sulci are bent in a zigzag manner, but it is an unusual appearance, for which I cannot account. By carefully removing part of the outer wall, each of the lamellæ is seen to be split near the exterior (not visible on casts), and each to be perforated by tubuli, as in Mr. Lonsdale's supposed genus *Tryplasma*; these punctures leave no trace on the equal, obtuse, smooth ridges of the cast. I have usually seen this coral ticketed

in collections as *Cyathophyllum turbinatum*, to which it bears some superficial resemblance, but has no real specific or even generic relation.

Very abundant in the Coniston limestone of Coniston; in the calcareous flags of Applethwaite Common; fine sandstone of Mulock quarry, Dalquorhan; flags of High Haume; slates of Llansaintfraid.

(Col. University of Cambridge.)

Petraia subduplicata (M'Coy).

Sp. Char. Regularly conic, slightly oblique and curved at the tip; outer wall thick, marked with one or two small interruptions of growth, and with fine, longitudinal, distant impressed equal striæ (seven in 2 lines, at a diameter of 5 or 6 lines); average length 9 lines, of which the 3 lines nearest the apex are filled with solid calcareous deposit; width 7 lines. Casts regularly conic, subtruncate at small end; length and width about equal, regularly sulcated by twenty-seven to twenty-eight strong, straight, primary lamellar sulci extending to the centre, where they are irregularly complicated into a large cellular mass; between the large slits are an equal number of finer ones, extending about three-fourths the length of the cast from the wide edge of the cup (representing the secondary lamellæ), which extend only a short way towards the centre.

Var. *a. crenulata*.

This beautiful variety differs from the ordinary type in the primary and secondary lamellar sulci, particularly towards the edge of the cup, being bent with numerous small angular zigzag flexures (perhaps from alternating projections on their sides). I might have supposed this to have been a small form of the *P. elongata* (Phill. sp.), if it was not for his reference to Lonsdale's figure (S. S. t. 16 bis, f. 6), which represents a distinct species which I have frequently seen; the lamellæ of the present species are also finer, the size smaller, and the form more regular, and the lamellar ridges of the cast never pitted. On the cast the lamellar sulci are regularly alternate in size, except at the strong simple odd one, on each side of which are two or three short ones.

Very abundant in the fine greenish sandstone of Mulock quarry, Dalquorhan; in the schists of Cynr y Brain, greenish schists of Llansaintfraid.

(Col. University of Cambridge.)

Petraia uniserialis (M'Coy).

Sp. Char. Corallum rapidly and regularly expanding, oblique,

averaging 5 lines in height and width, radiated with about forty-five or fifty lamellar sulci; average internal casts nearly 5 lines wide and 2 lines high, radiated by the deep slits of twenty-five strong primary lamellæ (six or seven in 3 lines at the margin) extending to the centre, where they are united and irregularly complicated; between each pair of these slits is a row of small, close, irregular, numerous pits (representing papillæ of the secondary lamellæ), about three in a space equaling the distance of the lamellar slits apart.

I frequently find this common species confounded with the *P. bina* (Lonsd.), which in form and size it resembles, but from which it differs completely in the primary lamellæ being simple plates extending to the complicated centre, leaving deep slits in the cast, which therefore has but one set of rows of pits instead of two; while in *P. bina* these lamellæ are replaced by a row of large papillæ, leaving a row of large pits in the cast, extending but a little way towards the centre. The secondary row of lamellar papillæ (and pits on the cast between the slits) is much smaller, closer and less regular in the present species than in the *P. bina*. Some of the casts present a depression in the smaller end, into which a process of the solid part of the apex must have penetrated. Between the lamellar sulci in some damaged specimens, obscure traces of cells seem doubtfully visible under the lens;—if these should prove to be vesicular plates, the species should be transferred to the genus *Strephodes*, thus removing it still further from *P. bina*, in which there is nothing of the kind.

Var. a. gracilis.

Certain casts a little longer and of a much more elongate form than the above, being about as high as wide, and having about thirty to thirty-six primary lamellar slits at a diameter of 6 or 7 lines, and an equal number of rows of close, small puncta, require separate mention, though I do not see that they differ in other respects.

Common in the schists of Pen lar Llandovery; Mathyrafal; Llansaintfraid and Castel Craig; fine sandstone of Alt y Anker. (*Col.* University of Cambridge.)

Cyathaxonia Siluriensis (M'Coy).

Sp. Char. Corallum elongate conic, about 5 lines long and 2 lines in diameter at that height from the base; strong central axis nearly one-third of the diameter; sixteen or seventeen strong radiating lamellæ, each extending from the axis to the outer wall, before reaching which it bifurcates, leaving a triangular interlamellar space about equal in width to the distance between the adjoining lamellæ; surface coarsely ridged

longitudinally; the sulci corresponding to the divided edges of the lamellæ, leaving one of the equal intervening ridges to correspond with each of the spaces between the individual lamellæ, and between their divided edges.

This is the only species of the genus I am aware of in the Silurian rocks.

Rare in the Upper Ludlow rock of Underbarrow, Kendal.

(Col. University of Cambridge.)

Spongarium æquistriatum (M'Coy).

Sp. Char. Elliptical, depressed, proportion of width to length varying from 85 or 90 to 100; marked with sharp, rugged concentric wrinkles; entire disk closely and evenly radiated by coarse rounded very approximate ridges, averaging five in 1 line. Long diameter from 8 lines to 1 inch.

This species is perfectly distinguished from its congeners by the coarse, close, equal striation of the entire disk, giving it a peculiarly harsh aspect; the ridges are much less than their thickness apart.

Rather rare in the quartzose Upper Ludlow rock of Benson Knot, Kendal.

(Col. University of Cambridge.)

Spongarium interlineatum (M'Coy).

Sp. Char. Broad oval, usual proportion of width to length as 85 to 100, marked with very strong concentric undulations; radiating ridges very numerous, straight, slender, simple, of unequal lengths, averaging with considerable regularity half a line apart; intervening spaces finely striated radiatingly; long diameter varying from 7 lines to 1 inch 3 lines.

This species is easily distinguished from the *S. Edwardsi* (Murch.) by having considerably more than double the number of radiating ridges; they have never been seen to dichotomize, but retain their comparatively near approximation by the intercalation of similar, straight, shorter ridges towards the circumference; the substance also appears stronger and is more strongly wrinkled concentrically; the small radiating striæ between the larger ridges are very characteristic.

One very obscure specimen, apparently of this species, measures 2 inches in its long diameter; the distance between the main ridges is about four times their thickness.

Abundant in the green micaceous quartzite of the Upper Ludlow at Benson Knot, Brigsteer and Scalthwaiterigg, Kendal.

(Col. University of Cambridge.)

Spongarium interruptum (M'Coy).

Sp. Char. Elliptical, proportion of width to length about 85 to 100, convex below or externally, concave above or internally; interior smooth, or marked with faint concentric wrinkles; exterior rugged with coarse concentric undulations, entire outer surface marked with sharp, subalternate, thread-like striæ, five or six in one line; some of which rise at irregular intervals into short, very thick, subangular, radiating ridges interrupted by the concentric wrinkles and not regularly resumed. Average length 1 inch.

The sharp alternately large and small striæ, and the short irregular interrupted ridges or elongate tubercles produced by the irregular prominence of some of the ridges, distinguish this species readily from the others. Two of the specimens are of great interest, one showing the attachment of the base half round a bit apparently of an *Orthoceratite*; the other showing for the first time the thickness of the substance to be about one-sixth of a line, and exhibiting the unradiated inner concave surface, and the impression of a part of the peculiarly radiated exterior.

Rare in the green micaceous quartzite (Upper Ludlow) of Spital, Kendal.

(Col. University of Cambridge.)

Nebulipora (M'Coy), n. g.

Gen. Char. Corallum incrusting or forming lenticular masses, with a concentrically wrinkled epitheca below; composed of small prismatic tubes perpendicular or nearly so to the upper surface on which they open; among the small tubes are irregularly arranged clusters of similar tubes of rather larger size; tubes in contact, traversed by horizontal diaphragms at regular distances (walls apparently perforated by rows of small foramina).

The *Favosites favulosa* (Phill.), Mem. Geol. Surv. vol. ii., is the only published species I know of this genus, which differs from *Favosites* in the clusters of enlarged tube-cells at subregular intervals; and from *Stromatopora* by the tubules being regularly prismatic, with diaphragms (? and connecting pores).

Nebulipora explanata (M'Coy).

Sp. Char. Corallum forming very thin, irregularly expanded laminæ, upwards of 2 inches long, covered with nearly regular quincuncially arranged nebular clusters of large tubes, flat or slightly depressed, about $1\frac{1}{2}$ line in diameter, and rather less than twice their diameter apart (about twelve or fourteen cells between one centre and the next); smaller intermediate tubes about six in one line.

To the naked eye the whole of the tubular structure of this coral is manifestly coarser than in the *N. lens*, from which it differs in its large irregular foliaceous expansions of growth; it also seems that the proportion (150 to an inch) of small cells in a given space was also greater in the *F. (Nebulipora) favosa* (Phill. sp.), to which I should have otherwise referred it.

Coniston limestone, Coniston.

(Col. University of Cambridge.)

Nebulipora lens (M'Coy).

Sp. Char. Corallum forming lenticular masses averaging 10 lines in diameter and $1\frac{1}{2}$ line thick in the middle, gradually thinning to the edge; base slightly concave, with small concentric wrinkles; upper surface evenly convex; clusters of large cells rounded, flat or slightly concave, about 1 line in diameter and usually a little more than their diameter apart (averaging from sixteen to twenty cells between one centre and another); smaller tubes averaging eight in one line, larger tubes of the clusters averaging four or five in one line; two interdiaphragmal spaces equal the diameter of the tube; apparently two irregular, close rows of connecting pores on each face of each tube.

When imperfectly developed or rubbed, it is difficult to recognize the imperfect star-like clusters or nebulae of the larger tubes. The structure not being composed of concentric layers round a central nucleus, and the appearance of the mouths of the tubes on the upper surface, easily distinguish this fossil from the *Stromatopora nummulitisimilis* (Lonsd.).

Owing to the minuteness and imperfect mode of preservation it is difficult to be satisfied about the connecting pores, but from the appearance under a high power of several specimens, I have little doubt they are as in the above notice.

In great abundance clustered like *Nummulites* in some parts of the fine Caradoc sandstone of Horderly West; more rare in the schists of Moel Uchlas?; Pont y Glyn, Diffwys; Cwm of the Cymmerig.

(Col. University of Cambridge.)

Nebulipora papillata (M'Coy).

Sp. Char. Corallum forming very thin layers (usually coating *Orthoceratites*); clusters of large cells elevated into conical papillae, about ten in each cluster; the papillae a little wider than high, usually about twice their diameter apart, quincuncially arranged; thickness of corallum usually less than half a line, diameter of papillae about half a line, distance apart about one line; of the smaller cells about nine or ten occupy one line.

Not very uncommon coating *Orthoceratites* in the Upper Ludlow rock of Brigsteer, and Coniston flags of Coniston, also at Firbank.

(Col. University of Cambridge.)

Favosites crassa (M'Coy).

Sp. Char. Corallum forming large, subcylindrical, curved branches, composed of long, slightly diverging, remarkably regular and equal prismatic tubes, opening as thin-walled polygonal cells on the surface, with a nearly uniform diameter of half a line; two rows of pores on each face of the prismatic tubes, diaphragms either slightly more or less than the diameter of the tubes apart; interpolated young tubes few.

In the general characters of the tubes and connecting foramina this species nearly agrees with *F. Gothlandica*, from which species it is distinguished by the elongate branch-like form of the general mass, the tubes averaging rather less than half the diameter, and being far more uniform in size than in that species, from the small number of interpolated young tubes, connected probably with the shape of the corallum, which is elongated instead of forming low wide masses as in *F. Gothlandica*. I suspect this to be the coral occasionally quoted as the Devonian *F. polymorpha* in Silurian rocks, a species which is very distinct from the present, and which I have never seen in Silurian strata, nor seen any recognizable figure of a Silurian specimen. As the essential characters are neither described nor figured, I do not like to refer to the figure (t. 15. f. 2) of the so-called *F. polymorpha* given by Mr. Lonsdale in the 'Sil. Syst.,' placed in the genus *Alveolites* by M. D'Orbigny under the name (without definition) of *A. Lonsdalii*, although the size of the tubes coincides.

Masses 2 inches in diameter and 6 inches long in the Coniston limestone, Coniston Water.

(Col. University of Cambridge.)

Cænites strigatus (M'Coy).

Sp. Char. Corallum forming cylindrical, dichotomous branches, 2 to 3 lines in diameter; surface with small, narrow, triangular cells, the base of the triangle below, and the apex usually more or less prolonged upwards into a vermiform channel, often upwards of half a line long; four to five rows of cells in the space of 1 line, measured transversely, about two in the same space measured longitudinally; compact interstitial space between the rows of cell-openings usually rather exceeding their width.

The usual compact appearance of the *Cænites*, combined in this species with the interrupted scratch-like channels of the cell-

mouths, completely distinguish it from any species of *Favosites* or *Stenopora*.

Not uncommon in the Wenlock limestone of Dudley, Staffordshire.

(Col. University of Cambridge.)

Palæopora? favosa (M'Coy).

Sp. Char. Corallum forming irregular rounded masses formed of prismatic tubes, opening as polygonal shallow cells on the surface (averaging $1\frac{1}{2}$ line in diameter in limestone, and about 1 line in sandstone); the dense narrow interspace or thick boundary-wall of the cells formed of one, or in places two rows of small cells; concave bottom of the stars very obscurely radiated with twelve irregular, rugged, nearly obsolete lamellar projections, scarcely distinguishable from a few intermediate granules, a small papillary axis in the centre: *vertical section*, clear open space of the tube, 1 to $1\frac{1}{2}$ line in diameter, separated by thick vertical walls (or very narrow dense interspaces of one or two rows of cells), traversed by strong distant horizontal, or slightly concave diaphragms, varying from the diameter to little more than half the diameter of the tubes apart.

It is very probable that this coral should form the type of a particular genus; the polygonal cells very narrow, dense interspaces, apparent absence of the circular tube of the cells, and small central axis, distinguish it from the other species of *Palæopora*. The large masses preserved in limestone are singularly like *Favosites Gothlandica*, the surface showing apparently the same sized and shaped polygonal hollow cells, with strong divisional walls, and the rough vertical section showing apparently prismatic tubes with distant diaphragms; a sharp eye or a lens however will detect the cellular structure of the divisional walls, and careful search will show the radiation, &c. of the cells; this is most distinct in a polished horizontal section. Specimens preserved in the fine sandstone present a very different appearance, forming small fig-shaped masses covered with hexagonal nearly smooth or very minutely granular convex or concave casts of the cells, with a distinct axial puncture in the centre of each. I have however connected them satisfactorily, though with difficulty, with the more perfectly preserved limestone examples.

Extremely abundant in the calcareous schists and limestone of Craig Head; Girvan; and in the fine sandstone of Mulock quarry, Dalquorhan.

(Col. University of Cambridge.)

Palæopora subtilis (M'Coy).

Sp. Char. Corallum forming cylindrical branches, usually $1\frac{1}{2}$ to 2 lines in diameter; large stellar tubes about one-sixth of a line in diameter, and a little more or less than their diameter apart; polygonal intervening tubuli invisible to the naked eye, usually five between adjacent cell-tubes, or about thirty in the space of 1 line; three cell-tubes with their intervening tubuli in a space of 1 line; main tubes often weathering as separate sulcated columns.

In the middle of the branches the cell-tubes seem to be parallel and vertical, but diverge rapidly at the circumference to reach the surface; they are very often weathered as separate tubuli, as in *P. subtubulata* and *P. tubulata*, and on the other hand they often break away from casts of the surface, leaving so little trace among the intervening tubuli, that the surface seems merely shagreened under the lens, bearing some resemblance to the *Ptilodictya* (*Stictopora*) *fucoides* (M'Coy), but the casts of the cells are polygonal instead of oval, and far more minute in the present coral. The extreme minuteness of the parts of this species distinguishes it easily from the *P. subtubulata*, to which alone it has any affinity.

Very common in the fine sandstone of Mulock, Dalquorhan, Ayrshire.

(Col. University of Cambridge.)

Fistulipora decipiens (M'Coy).

Sp. Char. Corallum forming hemispherical or subcylindrical masses 3 or 4 inches in diameter, concentrically wrinkled at base; cell-tubes straight, subparallel, with moderately thick walls, leaving clearly defined circular *smooth-edged* cells in the transverse section, very regular in size and disposition, usually slightly less than half a line in diameter, and averaging rather less than their diameter in the shortest line between adjacent cells, in which line there are usually two, or more rarely three, of the intermediate vesicular cellules; about eighteen of the intermediate or polygonal cellules in the space of 2 lines; diaphragms in the small tubes slightly more or less than their diameter apart, two interdiaphragmal spaces in the large tubes slightly exceeding the diameter.

So exactly does this resemble the *Palæopora interstincta* (Wahl.), that I have little doubt it has often been confounded with it, although an attentive examination will show that the distinctly walled tubes are smooth within and perfectly destitute of lamellæ. I have seen this coral also in large masses in the Upper Silurian limestone of Gothland. It may be distinguished from the very nearly allied *Manon* (*Fistulipora*) *cribrosa* (Gold. sp.), by

the smaller size of the cell-tubes and their greater number in a given space, their *proportionate* distance being pretty nearly the same. In both the British and foreign specimens the cells are so beautifully distinct, that it would be impossible to overlook the notches or rudimentary lamellæ if they existed.

Forming large masses not uncommonly in the Wenlock limestone near Aymestry.

(Col. University of Cambridge.)

POLYZOA.

Berenicea heterogyra (M'Coy).

Sp. Char. Parasitic, often on *Orthoceratites*, covering spaces of upwards of 2 inches square; cells disposed in irregular radiating, or divaricating, circular, or fan-shaped lines, ten or eleven occupying the space of 1 line (measured across their length), and about three in the same space in the direction of their length, each cell slightly more than the third of a line long, very narrow, fusiform, about four times longer than wide, and separated by a space, varying from their greatest width to less than one half their width or nearly in contact; upper convex surface of each cell with four or five large tubercles when well preserved.

The cells of this remarkable species are almost invisible to the naked eye, but it occurs forming patches of considerable size; the small size of the cells and their very elongate slender form distinguish this species from the *B. irregularis* of Lonsdale.

Coniston limestone of Coniston.

(Col. University of Cambridge.)

Ptilodictya explanata (M'Coy).

Sp. Char. Corallum forming large funnel-shaped foliaceous flexible expansions upwards of 2 inches wide; axis semimembranous, very thin, marked with small, close, concentric or forward-curved undulating wrinkles; tube-cells pyriform oblique, three or four times longer than wide, narrowed posteriorly, anterior ends of the adjacent cells convex rhomboidal, with a round perforation nearest the anterior edge; cells separated by depressed lines, which (when finely preserved) show one or two alternating rows of small cellules, about seven or eight cells in a space of 2 lines.

The broad foliaceous expansions of this species readily distinguish it from any of those described by Mr. Hall, as well as the very narrow depressed spaces between the cells on the surface, and the broad rhomboidal, convex portion of the cells surrounding the aperture. Finely preserved casts of the surface show

the strong granules on the ridges corresponding to the intercellular depressions of the true surface. Old specimens often show a few thick irregular branching ridges on the surface as in *Neuropora*. One young specimen is flat and oval, like the base of Say's *Favosites* (*Stenopora*) *Lycoperdon*, with which it might be confounded if the posterior tapering of the cell-tubes was not noticed; others are more elongate, conical; and the greater number of specimens are irregularly undulated fragments, parts of large expansions. The large, expanded, undulated and wrinkled axis when the cells are rubbed off, resembles species of *Stromatopora*; a careful search will usually show some remaining cells, or by rubbing down the thin axis some of the cells of the under side will be brought into view, when their comparatively greater size and oblique ovate form will identify them.

Very common in the slates of Mynydd Fron Frys; five miles west of Chirk; Llansaintfraid; Llanfyllin; Blain y Cwm; Cyn y Brain; Coniston limestone of Coniston; limestone of Mathyrafal; schists north end of Pen y Craig, above Glyn.

(Col. University of Cambridge.)

Ptilodictya costellata (M'Coy).

Sp. Char. Corallum frequently dichotomizing at an acute angle; average width about $1\frac{1}{2}$ line; surfaces gently convex, section acutely elliptical, edges acute, with a rather broad lateral margin, having a minutely granular non-celluliferous surface, each face averaging from seven to ten longitudinal rows of oblong or nearly oval cells, arranged in alternating lines (six to eight rows in the space of 1 line, about four or five cells in the same space in each row); cells about a third longer than wide and half their length between the rows, and about half their width between the cells of each row, giving the casts the appearance of being regularly marked with longitudinal sulci; intercellular spaces very minutely granulose.

The sulcated appearance of the cast and the linear arrangement of the cells easily distinguish this species from the *Stictopora* (*Ptilodictya*) *acuta* (Hall. sp.). By grinding down a fragment I have ascertained with certainty the presence of the flat internal axis, which is however of great delicacy, and not to be seen in the shale or sandstone specimens.

Not uncommon in the slates of Llansaintfraid; calcareous schists of Mathyrafal, and limestone of Girvan.

(Col. University of Cambridge.)

Ptilodictya fucoides (M'Coy).

Sp. Char. Corallum forming very thin, flat, submembranous, foliaceous, linear expansions, averaging $1\frac{1}{2}$ to 2 lines wide,

frequently dichotomizing at an acute angle, branches very rarely, but occasionally anastomosing; cells extremely small (eight in the space of 1 line), about eighteen rows in the width of the frond, very close quincuncially arranged, without perceptible linear disposition; internal axis smooth, nearly membranous.

The extreme minuteness, number and close disposition of the cells easily distinguish this species from the *P. acuta* or *costulata*, and often give the specimens a resemblance to some fucoid.

Not uncommon in the schists of Llansaintfraid; schists of Gelli Grin, Bala; and schists of Corwen.

(Col. University of Cambridge.)

Fenestella patula (M'Coy).

Sp. Char. Corallum forming small semicircular expansions about half an inch in diameter; interstices broad, strongly carinate, slightly flexuous, and dichotomizing very frequently (usually at rather less than every line in height), about seven in the space of 2 lines; fenestrules about one-third wider than the interstices, of very irregular shape, but nearly equal in length; dissepiments strong, about half a line apart; pores large, very prominent (about three to the length of an interstice).

This species is more nearly allied to the *Retepora* (*Fenestella*) *antiqua* of Goldfuss, than the Silurian species referred to it by Lonsdale (*F. subantiqua*, D'Orb.); from the latter species it is easily distinguished by its thick, widely divaricating and frequently branched interstices, the irregular shape of the fenestrules, and the much fewer and more prominent pores.

Not uncommon in the Wenlock limestone of Dudley.

(Col. University of Cambridge.)

Fenestella rigidula (M'Coy).

Sp. Char. Corallum formed of very slender ridged straight interstices, branching seldom (at distances of about every 10 lines), several interstices often branching at the same height, at a very acute angle, about ten interstices in the space of 2 lines; mesial keel very strong, with a row of small pores; fenestrules very regular in size and shape, quadrangular, slightly longer than wide, their width about equaling that of the interstice; usually three large thick-edged pores to the length of a fenestrule and one larger at the end of each dissepiment.

In size, mode of branching, and rigid straightness of the interstices, this is not unlike the *F. subantiqua*, but is completely distinguished by its closer dissepiments, forming shorter fenestrules, and its much fewer and larger pores. From the row of

pores on the keel, this would enter M. D'Orbigny's subgenus *Fenestellina*. I suspect, from some specimens I have seen, that it is possible some of the figures given by Lonsdale in the 'Silurian System' as the *Fenestella prisca* (Gold. sp.), may be coarse, inaccurate representations of this species; if this should even prove so, the name I propose should be retained, as it has no affinity with the large Devonian coral of Goldfuss, with which I am well acquainted.

Not uncommon in the Wenlock limestone of Dudley.
(Col. University of Cambridge.)

Retepora Hisingeri (M'Coy).

Sp. Char. Corallum forming irregular fan-shaped expansions, interstices about one-third of a line wide; dissepiments narrower than the interstices, fenestrules ovate, slightly angulated, about two-thirds of a line long and half a line wide (five interstices in the space of 2 lines); cells very small, from four to seven rows on the interstices, generally about three on the dissepiments (internally forming short ovate cells), about a third longer than wide, obverse, very minutely granular.

As it is scarcely possible even to determine Hisinger's *Retepora reticulata* with certainty, as he gives no information relative to the pores, there could be no objection to apply that name to the present species, which agrees with his figure as far as it goes, were it not that Mr. Lonsdale has already applied it to a very similar coral, which he however places in the genus *Fenestella*, and figures with only the two rows of pores usual in that genus.

Very abundant in the slates of Cefn Coedog; Cyn y brain, W. of Wrexham; Blain y Cwm, W. of Nantyre, Glyn Ceiriog; slates of Mynydd Fron Frys, five miles W. of Chirk; Coniston limestone of Coniston Water Head, Lancashire.

(Col. University of Cambridge.)

ECHINODERMATA.

Taxocrinus? Orbignii (M'Coy).

Sp. Char. Column cylindrical, about 2 lines in diameter at an inch from the pelvis, and not varying materially in character within 2 inches from the pelvis; joints finely granulated, uniform, two in the space of 1 line; pentagonal *pelvic plates* 1 line high, alternating with which are the pentagonal or obscurely heptagonal scapulæ, nearly $1\frac{1}{2}$ line long; arms of two quadrangular and one cuneiform joint each 1 line long, and $1\frac{1}{2}$ line wide, the latter giving off two hands of five joints, the last being cuneiform, and giving origin to two fingers; from pelvis to end of fingers 1 inch 3 lines.

I have not distinctly made out the interbrachial plates, but as there seems a notch between the upper adjacent edges of the scapulæ, I have little doubt they existed; besides their presence, the species is easily distinguished from the *Ichthyocrinus pyri-formis* (Phill. sp.), by the greater number of joints in the arms and hands, the much thicker column, and the nearly unvarying character of the joints as they approach the pelvis.

In the "Asterias" bed of the Upper Ludlow at High Thorns, Underbarrow.

(Col. University of Cambridge.)

Glyptocrinus basalis (M'Coy).

Sp. Char. Cup subpyriform, pelvic plates hexagonal, slightly exceeding the costals in length and supporting the intercostals on their upper truncated edge; all the plates marked with thick radiating ridges, one to each side, except in the pelvic plates, which have them only in the three upper sides, the lateral pair being the forked ends of the strong vertical ridge of the costal or radial rows; average length of cup from pelvis to base of rays, 1 inch 6 lines; width the same; length of pelvic plates $3\frac{1}{2}$ lines, pentagonal first costal 3 lines, hexagonal second costal $2\frac{1}{2}$ lines, heptagonal scapular plate 3 lines, hexagonal first arm plate $2\frac{1}{2}$ lines, second arm plate 2 lines.

This fine species differs from the *Glyptocrinus decadactylus* (Hall), of the Hudson River group of New York, by the great size of the pelvic plates, and their being hexagonal instead of pentagonal, and their bearing the intercostal plates directly on their truncated upper edge, the intercostals in the American species being supported on the sides of the laterally united *first costals*, which latter plates in this species are completely separated. The first arm-plates are laterally united without the intervention of an interbrachial plate, which exists however between the second arm-joints, nearly equaling them in size. In one of the most distinctly preserved intercostal spaces, three interscapular plates are seen to rest on the upper half of the octagonal intercostal, the lateral ones being pentagonal, and the middle longer one hexagonal. All the plates seem to have been thin, and allow considerable variety in form of the cup from slight pressure.

Not uncommon in the calcareous schists of Alt yr Anker.

(Col. University of Cambridge.)

CHAPTER VIII.

PROTOZOIC ANNULATA*.

Myrianites tenuis (M'Coy).

Sp. Char. Usually coiled in numerous, small, very irregular undulations; diameter of body about one-third of a line.

This beautiful little worm is easily distinguished from the *M. Macleayi* (Murch.) by its very slender proportions, agreeing more nearly in this respect with the *M. Murchisoni* of Prof. Emmons's "Taconic Slate." I think it was about a foot long, from following, as well as I could, the convolutions of three individuals. I have only in one part seen traces of the cirri, which have the same general proportions as in the *M. Macleayi* (Murch.).

Not uncommon in a particular layer of the fine olive slate of Greiston, on the Tweed, near Inverleithen.

(Col. University of Cambridge.)

Genus *Crossopodia* (M'Coy), n. g.

Etym. κροσσός, *fimbria*; πούς, *pes*.

Gen. Char. Body long, moderately slender, of excessively short, numerous, wide segments, from which arise very long, delicate, crowded cirri, forming a broad dense fringe on each side, completely concealing the feet (at least five or six times longer than a segment of the body, or interval between one cirrus and another).

These beautiful worms are easily distinguished from their protozoic companions, the *Nereites* and *Myrianites*, by the excessive shortness of the joints of the body, as indicated by the very crowded cirri (only one of which comes from the dorsal aspect on each side of any given segment) and by the broad, close, fringe-like development of these latter, concealing the lobes of the feet, so conspicuous in the two genera named.

Crossopodia lata (M'Coy).

Sp. Char. Length unknown (upwards of 1 yard); width 9 lines, width of body 3 lines, length of cirri 3 lines; articulation of body and number of cirri indistinct, but apparently three in a space of 1 line.

Prof. Sedgwick informs me, that the portion of this remarkable

* The species in this chapter date from the 'Annals' for May 1851.

worm which he saw in the rock, and of which the specimen described is a part, measured a yard in length, without signs of tapering or alteration of character, thus agreeing in proportion with its living allies. Its great width easily distinguishes it from the older *C. Scotica* (M'Coy), and it has no resemblance to any other fossils I know of. The piece described is about 4 inches long, and is gently flexuous.

Tilestone (Upper Ludlow) of Storm Hill, Llandeilo.

(Col. University of Cambridge.)

Crossopodia Scotica (M'Coy).

Sp. Char. Length unknown (upwards of 2 feet), width nearly 2 lines, width of body (and trail on the surface of the beds) one-third of a line; cirri very fine, close, delicate, about five in the space of 1 line.

This interesting worm is closely allied to the so-called *Nereites Loomisii* of Prof. Emmons's 'Memoir on the Taconic System,' t. 3. f. 3, from the taconic slates of Waterville, Maine. The American species certainly belongs to our new genus *Crossopodia*, but, if correctly drawn, has much thicker and fewer feet. The narrow deep *trail* of the middle part of the body on the upper surface of the planes of deposition of the slate, and the narrow cord-like ridge formed by the casts in them on the under surface of the laminæ, might possibly be mistaken for a different worm resembling a *Gordius*, without due caution or the absolute demonstration of their nature, afforded by many of the specimens.

Very abundant in the greenish slate of Thorney Lee quarry, on the Tweed, near Inverleithen.

(Col. University of Cambridge.)

Trachyderma? laevis (M'Coy).

Sp. Char. Tube slightly curved, thin, coriaceous, slightly tapering, subcompressed; slightly more than 1 line in diameter at the broad end, and slightly less than 1 line at the imperfect smaller end of a specimen 1 inch 7 lines long; surface nearly smooth.

The specimen is a brown, tough, flexible tube, irregularly and gently compressed (parallel to the plane of stratification of the rock), assuming an oval section; and being filled with the bright-coloured matrix shows clearly the thinness of the tube, which, from the same cause, has a few irregular indentations of the surface, which otherwise seems smooth.

Rare in the fine beds of Caradoc sandstone of Acton Scott, Church Stretton.

(Col. University of Cambridge.)

CHAPTER IX.*

SILURIAN MOLLUSCA.

Poterioceras ellipticum (M'Coy).

Syn. and Ref. *Orthoceras pyriforme* (Sow.), pars Sil. Syst.
t. 8. f. 19 (lower and not upper figure).

Sp. Char. Elliptical, last chamber conoidal; greatest width at last septum, from whence the chambered and unchambered portions taper elliptically to the contracted mouth and attenuated extremity; septa nearly horizontal, the last three or four about $2\frac{1}{2}$ lines apart: greatest width of last chamber (at septum) 2 inches 3 lines; length of last chamber 2 inches $4\frac{1}{2}$ lines.

There are clearly two species confounded by Sowerby in the 'Silurian System' under the name *Orthoceras pyriforme*; the difference in form he supposed to be produced by the direction of pressure, but I find it to be constant in perfectly uncrushed specimens. To that represented by his upper figure I would restrict his specific name *pyriforme*, its characteristic pear-shaped form being mainly owing to the greatest width being in the middle of the last chamber, or midway between the last septum and the mouth; the upper half of the last chamber being abruptly rounded, while the other portion of the shell tapers gradually. In the other species the greatest width is at about the last one or two septa, from whence the last chamber tapers gradually to the mouth with about the same curve that the chambered portion tapers towards the apex, giving a very different, regularly elliptical, figure to the present species, which I have named accordingly.

Common in the Lower Ludlow rock near Aymestry.

(Col. University of Cambridge, &c.)

Phragmoceras intermedium (M'Coy).

Syn. and Ref. *P. arcuatum* (Sow.), pars Sil. Syst. t. 11. f. 1.
(not t. 10. f. 1^a).

Sp. Char. Slightly arched, tapering at the rate of 4 lines in 1 inch; section ovate, sides gently convex, outer and inner faces rounded: a specimen (not quite perfect) 2 inches 5 lines long

* The species in this chapter date from the 'Annals' for January 1851.

has the long (antero-posterior) diameter at the large end 1 inch 4 lines, at the small end 9 lines; short (lateral) diameter at large end 10 lines; length of last chamber 1 inch 1 line; the last five or six septa $1\frac{1}{2}$ line apart in the middle of the side.

I have not clearly seen the siphon of this species, which is about as thick and slightly arched as the *P. arcuatum* (of which it is figured as a separate variety by Sowerby), but tapers much more slowly as in the *P. compressum*.

Not uncommon in the green mudstone (Lower Ludlow rock) of Green quarry, Leintwardine.

(Col. University of Cambridge, &c.)

Cycloceras tenui-annulatum (M'Coy).

Sp. Char. Nearly cylindrical (tapering half a line in 2 inches at a diameter of 6 lines); rings narrow, sharply defined, half a line wide, slightly oblique, six in half an inch at the above dimensions; surface with very minute, longitudinal, equal striæ, twelve or fourteen in a space of 1 line; towards the small end a few circular striæ on each ring decussating the longitudinal lines.

This species differs constantly from the *Orthoceras* (*Cycloceras*) *Ibex* by the narrower and more sharply defined rings, and their considerably greater number in a given space in specimens of the same size; the longitudinal striation is even finer than in that species.

Not uncommon in the green Lower Ludlow mudstone of Green quarry, Leintwardine, and near Aymestry; rare in the Upper Ludlow quartzite of Brigsteer, Kendal.

(Col. University of Cambridge.)

Orthoceras politum (M'Coy).

Sp. Char. Very elongate, conic, regularly tapering at the rate of half a line in 1 inch, from a diameter of 7 lines; from which size to 5 lines, the septa have a uniform distance of 3 lines apart; they are slightly oblique, convex, with even edges; siphon moderate, excentric, its own diameter from the centre; surface smooth.

One specimen with a glossy, horn-like external surface, slightly imperfect at each end, measures 1 inch 4 lines in diameter at the mouth, is 1 foot 8 inches long, and measures 2 lines in diameter at the smaller end, where the septa are slightly oblique, and $1\frac{1}{3}$ line apart.

Not uncommon in the impure calcareous concretions of Glenquapple, Scotland.

(Col. University of Cambridge.)

Bellerophon subdecussatus (M'Coy).

Sp. Char. Globose, of one and a half or two very rapidly enlarging whorls, subcompressed towards the very obtusely angular or rounded circumference; sides gibbous; umbilicus small, deep, partially exposing the whorls; diameter $4\frac{1}{2}$ lines; in proportion to diameter, width $\frac{8.7}{100}$, length of mouth $\frac{8.5}{100}$, diameter of umbilicus $\frac{2.0}{100}$; surface with strong transverse ridges arching backward from the umbilicus to the undefined band, forming a wide V-shaped sinus; about four or five of these transverse ridges in the space of 1 line near the mouth; they are crossed by much finer spiral striæ, about the same distance apart, from one to three of which are usually stronger than the rest near the band.

This species is extremely like the carboniferous *B. decussatus* (Flem.), but has the transverse striæ much stronger than the spiral ones.

Rare in the schists of Llanrwst and fine sandstone of Mulock, Dalquorhan, Ayrshire.

(Col. University of Cambridge.)

Holopella (M'Coy), n. g.

Gen. Char. Shell spiral, elongate, slender, of numerous gradually increasing whorls, generally crossed by slightly arched striæ; mouth circular, with the peritreme entire; base rounded, with or without a minute umbilicus.

These shells have hitherto been confounded with the recent genus *Turritella*, from which they differ completely in the entire peritreme and definite round margin to the mouth, thus approaching much nearer to *Scalaria*. From *Chemnitzia* they differ in the smaller size of the body-whorl, and in neither it nor the mouth being produced anteally.

Holopella gracilior (M'Coy).

Sp. Char. Very slender, spiral angle 15° , whorls smooth (number unknown), slightly and evenly convex, suture deep, simple, sutural angle 95° ; width at base 5 lines, length of last whorl 3 lines.

This is distinguished from the *H. obsoleta* by its more slender spire (as indicated by the difference in their spiral angles), less convex whorls, &c.

Schists of Dinas Bran, Llangollen.

(Col. University of Cambridge.)

Holopella intermedia (M'Coy).

I provisionally give this name to a species agreeing exactly,

so far as I can see, with the *H. obsoleta* (Sow. sp.), but having an apical angle of 30° , being thus exactly intermediate between it and the *H. conica* (Sow. sp.), striking the eye as manifestly shorter than the former, and more slender than the latter. Length about 7 lines, width 3 lines, length of last whorl $2\frac{1}{2}$ lines.

Not uncommon in the state of casts in the Upper Ludlow rock of High Thorns Underbarrow, Kendal, Westmoreland.

(Col. University of Cambridge.)

Holopella monile (M'Coy).

Sp. Char. Very slender, apical angle about 10° , spire of about nine whorls (six preserved), each turn a little wider than long, exceedingly convex, sutures deep, simple. Length $3\frac{1}{2}$ lines, width 1 line, length of last turn slightly less than 1 line.

The small size, extremely slender form, and very convex whorls, render it impossible to confound this with any other species.

Rare in the schists of Selattyn Road.

(Col. University of Cambridge.)

Litorina undifera (M'Coy).

Sp. Char. Turreted, broad, ovate; spire pointed, about three-fourths the length of the body-whorl; apical angle about 80° ; sutures channeled, having a little below them a thick spiral ridge undulated by about eight vertical depressions, which cross the whorls of the spire and upper part of the body-whorl; below this ridge is a wide concave space bounded by a second thick undulating ridge, forming the most prominent part of the whorl; beneath this second ridge on the body-whorl are about ten very delicate, subequal, spiral threads distinctly separated by concave spaces, about two of which only are visible on the turn of the spire; entire surface crossed by very close, minute, direct lines of growth. Length 3 lines, length of body-whorl 2 lines, width slightly more than 2 lines.

This resembles some of the small oolitic *Pleurotomariæ*, but there is clearly no sinus in the lip, as indicated by the direct lines of growth, and the shell is no doubt congeneric with the *L. carinata*, from the young of which the undulations, &c. distinguish it.

In the Aymestry limestone of Mortimer's Cross, Aymestry.

(Col. University of Cambridge.)

Loxonema elegans (M'Coy).

Sp. Char. Spire very slender, elongate-conic, apical angle about 20° ; of about six elongate evenly convex volutions, crossed by thread-like striæ, arching forward at their ends, and with a

broad backward wave in the middle (about three in the space of 1 line); sutures deep, simple, sutural angle 100° . Length 1 inch 11 lines, length of last whorl 9 lines, width $7\frac{1}{2}$ lines.

The greater length and slenderness of the whorls and the broader and more shallow wave in the striæ separate it from the so-called *Terebra sinuosa* (Sow.).

In the gray flags of Pont y Meibion; slates of Llansantfraid, Glyn Ceiriog.

(Col. University of Cambridge.)

Turbo crebristria (M'Coy).

Sp. Char. Ovate, of three to four very rapidly enlarging volutions; spire small, apical angle about 90° , whorls convex, with an obtusely bounded narrow concave space at the sutures above, back broad, gently convex; umbilicus narrow, deep, effuse at the edge, mouth very large, obscurely angulated retrally; shell thick, surface girt with sharp spiral thread-like ridges, nearly twice their thickness apart, about four in the space of 1 line on the penultimate whorl, with an occasional finer one between a regular pair, all crossed obliquely by very fine, regular, sharp lines of growth. Length (of small perfect specimen) 1 inch, width 1 inch, length of body-whorl 8 lines (grows to nearly 2 inches in diameter).

The large casts of this species are smooth, and resemble Sowerby's figure and description of *T. Priceæ*, except that the back is broad and rather flattened, or slightly convex instead of being angular in the middle as that species is defined to be. The substance of the shell is thick, and its mode of striation resembles that of the so-called *Pleurotomaria bilix* of Conrad as figured by Hall (Palæontology of New York), which is however distinguished by its smaller size, longer spire and want of an umbilicus.

Common, of large size, in the schists of Gelli Grin, Bala, Merionethshire; in the fine sandy schists of Mandinam, Llandovery; in the fine sandstone of Alt yr Anker, Meifod, Montgomeryshire; and in the limestone of Mynydd Fron Frys, five miles west of Chirk, Glyn Ceiriog.

(Col. University of Cambridge.)

Trochus calatus (M'Coy).

Sp. Char. Conical, apical angle 80° ; spire of three and a half flattened volutions, having a thick rounded keel forming the circumference of the basal whorl, and close to the suture on the spiral whorls; base flattened; surface marked with oblique

scaly ridges. Length $2\frac{1}{2}$ lines, width 4 lines, length of last whorl 1 line.

Owing to the scaly nature of the ornament on the rather wide oblique ridges of the surface, they usually adhere to the matrix, and breaking off from the shell leave it nearly smooth.

Very rare in the limestone of Old Radnor, Presteign, Radnorshire.

(Col. University of Cambridge.)

Trochus constrictus (M'Coy).

Sp. Char. Conical, apical angle about 70° , of four or five gradually increasing whorls, each with a shallow concavity or constriction below the suture, the lower portion strongly rounded, base flattened, circumference obtusely rounded; surface obliquely crossed by fine, unequal, often obscurely fasciculate lines of growth; mouth transverse, obliquely ovate. Length 8 lines, width $7\frac{1}{2}$ lines, length of mouth $3\frac{1}{2}$ lines, width of mouth 4 lines.

This seems allied to the *Holopea symmetrica* (Hall) of the Trenton limestone, but the spire is not so elevated, the base is more flattened, and the mouth is stated to be almost circular in that species, which besides has the whorls regularly convex from the simple suture.

In the schists on the Bala limestone, Bryn Melyn quarry near Bala; Cymmerig, Bala, Merionethshire.

(Col. University of Cambridge.)

Trochus Moorei (M'Coy).

Sp. Char. Acutely conical, apical angle 50° , of about five (four preserved) flattened, gradually increasing whorls; mouth transversely subquadrate; base flattened, moderately convex; umbilicus deep, narrow; surface unknown. Length about 8 lines, width 6 lines, length of mouth 3 lines, width of mouth $3\frac{1}{2}$ lines.

I dedicate this very distinct species to J. Carrick Moore, Esq. (Secretary of the Geological Society), who has devoted much labour to the elucidation of the old fossiliferous rocks of Scotland.

In the fine sandstone of Dalquorhan near Girvan, Ayrshire.

(Col. University of Cambridge.)

Cucullella (M'Coy), n. g.

Gen. Char. Subrhomboidal, inequilateral, subequivalve, margins even; hinge-line entirely crenulated; muscular impressions

two, with a simple pallial scar between them ; a strong internal septum extends from before the beaks to the posterior margin of the anterior adductor, forming a deep slit in the casts. Surface generally smooth or nearly so.

These palæozoic shells have been confounded with *Cucullæa* (by Sow., Phill., &c.), from which they differ in wanting the hood-like plate of the posterior adductor, and having the septum in the anterior end, and with *Clidophorus* (in Geol. Surv. of Great Brit. vol. ii. pt. 2), from which they differ in having the hinge crenulated as in *Arca*.

Tellinites affinis (M'Coy).

Sp. Char. Elliptical, moderately convex ; beaks small, about one-third the length from the anterior end, which is elliptically rounded, and with an undefined obtuse cardinal slope ; ventral margin nearly straight, with a faint, shallow sinus in the middle ; posterior like the anterior end, rounded elliptically, with sometimes an almost imperceptible flexure (as in *Tellina*) extending as a hollow in the left valve towards the beak from a small sinus in the margin beneath the posterior end ; surface smooth, or with a few obtuse marks of growth. Length 1 inch $4\frac{1}{2}$ lines, width (from beak to opposite margin) $\frac{4.5}{100}$, length of anterior end $\frac{30}{100}$, depth of valve $\frac{1.5}{100}$.

This has almost exactly the shape of our recent *Tellina radiata*, but the minute flexure above alluded to is in the longer end (which in that species is the anterior). The species is most allied to the *Tellina obliqua* (Gold.) from the grauwacke of Ems, from which it differs in being less transverse, in the beaks not being mesial, and in the less angularity of the posterior slope ; its greater length, less central beaks, and concave ventral margin distinguish it from the *Nuculites subemarginata* (Conrad).

Rare in the Upper Ludlow rock of Benson Knot, Kendal, Westmoreland.

(Col. University of Cambridge.)

Arca (Byssarca) subæqualis (M'Coy).

Sp. Char. (Cast.) Oblong, equivalve, nearly equilateral, ends subtruncate, rounded, very gibbous in the middle, about twice as long as wide ; depth of both valves equal to the width ; beaks very large, obtuse, tumid, marked on the sides with four or five large wrinkles ; a shallow sinus for the byssus in the ventral margin a little nearer the anterior than the posterior end, and slightly obliterating the simple pallial scar ; adductor impressions deep, rounded ; hinge-teeth very numerous, small, equal, at right angles to the hinge-line. Width 10 lines, length 1 inch 8 lines.

In t. 20. f. 1. of the 'Silurian System,' Mr. Sowerby seems to have united two distinct fossils (the differences between which have been noticed by various writers) under the one name, *Arca Eastnori*; the fig. 1 *a*. from Eastnor Park should, from the name, be considered the type of the species, and is a regular, subcompressed, oval shell without ventral sinus, while the other, fig. 1 *b*,—of which Mr. Sowerby says, "If it be not an old shell grown very thick, it may be a different species,"—may I think possibly be referred to the present fossil.

In the gray micaceous sandstone of Llechclawdd, Myddfai.
(Col. University of Cambridge.)

Arca Edmondiiformis (M'Coy).

Sp. Char. Oblong, obtusely subquadrate, very gibbous; beaks very large, tumid, about one-fourth of the length from the anterior end, which is obtusely rounded; ventral margin slightly sinuate in the middle; posterior end very slightly oblique, obtusely rounded; hinge-line nearly straight, as long as the shell, with numerous minute teeth inclining slightly towards the beak; surface smooth or with minute wrinkles of growth. Width 5 lines, length $7\frac{1}{2}$ lines, greatest depth of one valve (at middle) $2\frac{1}{2}$ lines.

This species resembles a small *Modiolopsis* or *Edmondia* in form, but in some of the specimens the hinge-teeth are seen as in *Arca*, except that they incline slightly towards the beak instead of from it.

In the fine sandy beds near Llangynyw Rectory, Montgomeryshire; sandstone of Alt y Gader; in the Upper Ludlow Rock of Benson Knot, Kendal, Westmoreland; Moel Seisiog, Llanrwst; Bala, Merionethshire; and Ab Hirnant.

(Col. University of Cambridge.)

Dolabra elliptica (M'Coy).

Sp. Char. Elongate, elliptical, length slightly more than twice the width; beaks obtuse, moderate, one-sixth of the length from the anterior end; anterior end small, elliptically rounded; ventral margin slightly convex; hinge-line slightly elevated; posterior end obliquely rounded; valves moderately convex; diagonal ridge very obtusely rounded, posterior slope steep, but not abruptly flattened; surface apparently marked with fine lines of growth. Length 1 inch 6 lines, width from beak to opposite margin 8 lines, width from ventral margin to end of hinge-line about the same, depth of one valve 3 lines.

The specimen described shows that in the left valve there were no other teeth but the thick elongate posterior one or ligamen-

tary ridge, which is about a line below the hinge-margin. This differs from the *D. obtusa* (M'Coy) in its narrow, elongate elliptical figure and less gibbosity.

Tilestone of Storm Hill, Llandeilo.

(Col. University of Cambridge.)

Dolabra obtusa (M'Coy).

Sp. Char. Obliquely ovate, width about three-fifths of the length, gibbous; beaks large, obtuse, nearly in the centre of the hinge-line, and one-fourth of the length from the anterior end; anterior end small, gradually curving into the ventral margin, which is only slightly convex, oblique to the hinge-line; posterior end obliquely subtruncate, the inferior angle obtusely rounded; posterior slope abrupt, inclined, the diagonal ridge obtusely rounded; surface nearly smooth. Width 10 lines, length 1 inch 5 lines, greatest depth of one valve (half-way between the beak and posterior angle) 4 lines.

This species is more obtusely rhomboidal, and is more obtusely keeled, has a longer hinge, and is much less elongate than the *Cucullæa amygdalina* (Phill.), which is only a common variety of the *C. unilaterialis* (Sow.), from which this differs by its thick posterior tooth, &c. The thick, elongate posterior tooth in the right valve is simple, and about two-thirds the length of that part of the hinge-line from which it declines; in some parts the hinge-line shows obscure traces of serrature, which may be owing to the roughness of the matrix.

Tilestone of Storm Hill, Llandeilo.

(Col. University of Cambridge.)

Anodontopsis (M'Coy), n. g.

= *Microdon*? Conrad (not Agassiz nor Meigen).

Gen. Char. Equivalve, inequilateral, compressed; general form rotundato-quadrate or subtrigonal; posterior side wide, round or obliquely subtruncate, anterior end slightly contracted in front of the beak; beaks small, prominent, nearer to the anterior than the posterior end; hinge-line shorter than the shell, with a posterior, long, slender lateral tooth or cartilage plate extending just below it (double in the right valve), and another similar but shorter one in front of the beaks; anterior muscular impression simple, ovate, longer and stronger than the posterior; occasionally a slight clavicular extends from in front of the beak behind the anterior adductor impression leaving a furrow in the cast; pallial impression entire (occasionally one small cardinal tooth beneath the beak); surface smooth or concentrically lined.

Except in their small size and marine habits, these little fossils

resemble the recent Anodons, from which there being but two simple adductor impressions separates them. They differ from *Modiolopsis* (or *Cypricardites*) in their rotundato-quadrate compressed form, and the posterior adductor impression like the anterior one, and they have no trace of the byssiferous sinus so common in that group between the body of the shell and the anterior side: from *Schizodus* (*Myaphoria*), with which Prof. King seems to have blended them, they are distinguished by the long, slender, posterior cartilage plate or lateral tooth a little below the hinge-line. Except in form they are identical with *Clidophorus*, and should be considered but as a subgenus thereof, distinguished from those long narrow types by their broad rounded or oblique axe-like form, more prominent beaks, and less marked clavicular ridge. From the figure of *Microdon bellastria* (Conrad) I should have imagined it belonged to the present genus, but his description of the hinge renders it probable that this genus is different, and I accordingly give a description of my own clear types, besides which the name *Microdon* was applied long previously to a genus of fish and one of insects.

Anodontopsis angustifrons (M'Coy).

Sp. Char. Longitudinally subtrigonal, compressed (depth of both valves half the width), diagonally subcarinate from the beaks to the respiratory angle; beaks small but prominent, rather more than one-fourth of the length from the anterior end, which is much narrowed and abruptly compressed beneath the beaks, produced, rounded, not separated from the body of the shell by any sinus; ventral margin nearly straight; hinge-line short, slightly elevated, forming a wide compressed posterior slope, the margin of which is almost uniformly arched from the beaks to the respiratory angle, which is obtusely pointed; surface nearly smooth, a few obscure concentric wrinkles of growth near the margin. Width from beak to ventral margin 6 lines, length 1 inch 2 lines, width from middle of dorsal to opposite ventral margin $\frac{5.6}{100}$, length of anterior end $\frac{2.5}{100}$. Pallial and muscular impressions as in the generic characters.

The more arched and elevated hinge-line and narrow anterior side separate this from the *Pullastra levis* (Sow.), which seems to belong to the same genus; and the contracted anterior end and greater length separate it from the *A. quadratus* (M'Coy). The posterior lateral tooth or plate extends almost to the end of the hinge-line and close to it.

Common at Benson Knot, Kendal, Westmoreland, and Kirkby Moor, Kendal, Westmoreland.

(Col. University of Cambridge.)

Anodontopsis quadratus (M'Coy).

Sp. Char. Rotundato-quadrate, slightly oblique, with about three-fourths of the length compressed, slightly and evenly convex, the posterior ridge obtuse, and posterior slope obscurely marked; beaks very small, subcentral; anterior and posterior sides of nearly equal width, the former broadly rounded, the latter with an obscure, slightly oblique truncation; dorsal margin slightly arched, ventral margin nearly straight, slightly convex. Width $9\frac{1}{2}$ lines, length 1 inch.

The peculiar figure produced by the shortness of the posterior side and less convexity easily distinguish this from the *A. leviss* (Sow. sp.) Casts show the anterior ovate adductor, a faint clavicular ridge extending from in front of the beak to its upper posterior edge; a short cardinal tooth under the beak, and the slender anterior and posterior lateral teeth close under the margin, the latter extending almost to the end of the hinge-line.

Common in the tilestone of Storm Hill, Llandeilo.

(Col. University of Cambridge.)

Anodontopsis securiformis (M'Coy).

Sp. Char. Subrhomboidal, compressed, sides evenly convex; diagonal ridge angular, sharply defined towards the beak; slightly concave towards the posterior slope, which is flattened and steep; beaks small, prominent, about one-fourth of the length from the anterior end, which is semicircularly rounded; ventral margin regularly convex; posterior end narrowed, obliquely truncated, with a straight edge; hinge-line straight, as long as the truncated posterior edge, internal posterior cardinal ridge very delicate, close under the hinge-line; anterior adductor small, oval, with a short slender ridge from the beak to its posterior edge. Length 10 lines, proportional width $\frac{6.8}{100}$, length of anterior end $\frac{2.5}{100}$, length of anal edge $\frac{4.5}{100}$, depth of one valve $\frac{1.5}{100}$.

There is some slight variation in the proportional width of this species, the shortest varieties of which are however much larger and with a more acutely truncated posterior end than the *Cypriocardia deltoidea* or *Isocardia axiniformis* (Phill.) of the carboniferous and (?) Upper Devonian (of S. Petherwin) rocks, to which the species is most allied.

Common in the green micaceous quartzite (Upper Ludlow) of Benson Knot, Kendal, Westmoreland.

(Col. University of Cambridge.)

Clidophorus ovalis (M'Coy).

Sp. Char. Oval, width two-thirds the length; anterior and pos-

terior ends almost equal, elliptically rounded, ventral margin gently convex; valves slightly and evenly convex, the posterior slope very slightly compressed; surface apparently smooth; clavicular ridge strong, reaching rather more than half-way from the beak to the ventral margin. Width $3\frac{1}{2}$ lines, length 5 lines.

This is distinguished from the *C. planulatus* (Conrad) by its regular oval form, larger and more oblique clavicular ridge and less elongation, and from the *Cucullæa* (*Cucullella*) *antiqua* (Sow.) by the flatness and oval outline of the valves.

Plas Madoc, N. of Llanrwst; abundant in the schists, Dolydd Ceriog Waterfall, E. of the Berwyn Mountains.

(Col. University of Cambridge.)

Tellinomya lingulicomis (M'Coy).

Sp. Char. Obovate, slightly and evenly convex; beaks small, compressed, not prominent, close to the anterior end, which is broadly rounded; dorsal and ventral margins slightly convex, converging towards the narrow posterior end, which is truncated more or less obliquely, about two-thirds the width of the shell under the beaks, and has an almost imperceptible sinus between its inferior angle and the ventral margin; surface with fine irregular imbricating plicæ of growth. Width 6 lines, length 1 inch 1 line.

This is much allied to the *T. nasuta* (Hall) of his Trenton group, but is smaller, shorter and more regularly ovate. It has somewhat the form of *Cardinia* with the delicate shell and edentulous hinge of *Anodon*. I believe this is about the oldest known Lamellibranch, occurring in considerable abundance among the *Lingule* in the slates near Tremadoc, and from being about the same size and texture may be confounded easily with them when crushed.

Slates, Penmorfa, Tremadoc.

(Col. University of Cambridge.)

Sanguinolites anguliferus (M'Coy).

Sp. Char. Oblong, length three times the width; beaks small, half the width from the anterior end, which is subquadrate, rounded; posterior end subtruncate, not oblique, scarcely wider than the width of the shell from the beak to the ventral margin; dorsal and ventral margins straight, almost parallel; a strong diagonal ridge runs from the beak to the inferior posterior angle, immediately in front of which is the deepest part of each valve; from the beak to the anterior end is marked by eight or ten narrow rounded ridges running obliquely down-

wards and backwards towards the middle of the ventral margins; a few of them meet at an acute angle, about the middle of the shell, with a few, more nearly vertical ridges proceeding from the great diagonal ridge; most of both sets of ridges go towards the ventral margin; they are separated by flat spaces wider than their own diameter; the posterior slope is divided into three broad, rounded radiations by three shallow impressed lines, crossed by irregular wrinkles parallel with the posterior margin, all the ridges are slightly undulated by the faint plicæ of growth; posterior dorsal lunette very narrow, concave, horizontal (or perpendicular to the plane of the valves). Length 3 lines, width 1 inch 4 lines.

A specimen of the right valve shows rather more of the angular ridges, though a smaller individual than one of the left.

Rare in the tilestone of Benson Knot, Kendal, Westmoreland. (Col. University of Cambridge.)

Leptodomus globulosus (M'Coy).

Sp. Char. Globose, subtrigonal, width three-fourths of the length; beaks very large, a little nearer the anterior than the posterior end; sides evenly tumid, most so in the middle; posterior slope undefined, but very steeply sloped; anterior and posterior ends subequal, slightly contracted, rounded, ventral margin convex; hinge-line a little shorter than the shell, not elevated, inflected portion narrow; surface with a few concentric lines of growth. Length $7\frac{1}{2}$ lines, width 6 lines, depth of one valve 2 lines.

This departs so widely from either the shortest or most gibbous varieties of the *L. amygdalina* (Sow. sp.), that it seems desirable to give it a distinctive name; there is no other closely allied form. The general appearance approaches that of the *Nucula ovalis* of the same group, but in the latter the diagonal posterior ridge is more angular, and I have ascertained that it really possesses teeth as in *Nucula*.

Hard green micaceous Upper Ludlow rocks of Tenterfell, Kirkby Moor, and Benson Knot, Kendal, Westmoreland.

(Col. University of Cambridge.)

Leptodomus truncatus (M'Coy).

Sp. Char. Oblong or subtrigonal, compressed; beaks very large, gibbous, prominent, terminal, the anterior end being almost vertically subtruncate under it, width of the anterior end (where it is greatest) nearly two-thirds the length of the shell; posterior end obliquely subtruncate or rounded; ventral margin gently convex, with a scarcely perceptible sinus a little

behind the vertical line of the beaks; surface rugged, with strong, thick, irregular wrinkles from the anterior end, becoming obsolete on the posterior slope. Width from beak to ventral margin 1 inch, length 1 inch 5 lines, depth of one valve about one-third of the width.

This is somewhat allied to the *Cypricardia retusa* (Sow.), but has the anterior end even more vertically truncate; it is more elongate (although in this point it varies considerably); but it is most obviously distinguished by the strong wrinkling of the surface, parallel with the ventral edges, by which latter, as well as the great depth of the truncated anterior end, it also differs from the *C. impressa* (Sow.).

Upper Ludlow rock, Benson Knot, Westmoreland.
(Col. University of Cambridge.)

Modiolopsis inflata (M'Coy).

Sp. Char. Longitudinally oblong, very gibbous; beaks obtuse, incurved, large, close to the anterior end, which is large and obtusely rounded; an obtuse sigmoidal ridge extends from the beak to the posterior inferior end, which is elliptically rounded to the very obtuse cardinal angle, which is slightly elevated; hinge-line little more than half the length of the shell, with a slender cartilage ridge just below it; ventral margin very slightly concave in front of the diagonal gibbosity. Width $9\frac{1}{2}$ lines, length 1 inch 6 lines, greatest depth of one valve (about one-third the length from the beak) 4 lines. Surface with minute irregular plications and lines of growth.

Pen Cerrig Serth (very common).

Distinguished from all the varieties of the *M. modiolaris* by its greater gibbosity, shorter hinge-line, and broader anterior end.
(Col. University of Cambridge.)

Modiolopsis (? *Orthonota*) *postlineata* (M'Coy).

Sp. Char. Oblong, twice as long as wide, shell thin, moderately convex; beaks small, near the anterior end, which is obtusely rounded; no byssal sinus; posterior end obtuse, obliquely rounded; dorsal and ventral margins nearly parallel, straight; hinge-line two-thirds the length of the shell, with a nearly parallel delicate hinge-plate running beneath it and nearly parallel with the erect dorsal margins; surface with minute obsolete transverse wrinkles of growth, except of the flattened posterior slope, which is radiated with fine close equal striae from the beak. Width from the beak to the ventral margin 5 lines, length 1 inch.

Some specimens bear a rough general resemblance to the *Nu-*

culites poststriata (Emmons), but they are distinguished by the parallelism of the dorsal and ventral margins, smaller beaks, greater transverse diameters, &c. It also closely resembles the *Cypricardites sectifrons* of Conrad, but that is figured with radiating lines on the sides as well as the posterior slope; the anterior part of our specimen is unfortunately imperfect.

Alt yr Anker, Meifod, Montgomeryshire.

(Col. University of Cambridge.)

Ambonychia ? acuticostata (M'Coy).

Sp. Char. Ovate, moderately and evenly convex, most so towards the beak; surface radiated with numerous angular ridges, only separated by the angular sulcus formed by the meeting of the steep sides of the ridges (about six ridges in one-fourth of an inch of the margin at half an inch from the beak).

In form and number of the ridges this resembles the small specimen of *A. carinata* (Gold. sp.) figured in Hall's 'Palæontology' (pl. 80. f. 5), but it is distinguished by its ribs being angular and close together—they being rounded and separated by flat interspaces in the American form. Only one imperfect specimen, measuring 7 lines from beak to ventral margin.

In the green schists of Dinas Bran, Llangollen.

(Col. University of Cambridge.)

Avicula ? Danbyi (M'Coy).

Sp. Char. Obliquely ovate, anterior end broadly rounded, posterior end more or less narrowed, rounded, ventral margin evenly convex; hinge-line rather less than half the width of the shell, posterior wing scarcely twice the length of the anterior, both wings nearly rectangular with slightly concave margins; left valve gently convex, most gibbous near the beaks, marked with minute concentric, irregular, interrupted striæ and wrinkles, crossed by a variable number of obtuse ridges radiating from the beak, and generally becoming obsolete towards the margin; right valve flat, with slight irregular concentric wrinkles and striæ of growth, without radiating ridges.

This species varies much in the amount of its obliquity and transverse elongation, and the number of radiations on the left valve; these latter resemble the radiation of *Pholadomya*, for which that valve might be taken when the ears are concealed. Traces of a subcentral muscular impression occasionally visible. Some of the varieties are so slightly oblique as to assume a rotundato-quadrate form. Average length 1 inch 5 lines, width 2 inches 3 lines, length of hinge-line 1 inch.

Traces of two fine internal ridges diverging from the beak of the flat valve where the wings join the body of the shell (resembling those of *Pecten*). The specific name was suggested by Mr. Salter for this species, if it should prove new, in honour of one who has diligently collected these remarkable fossils, and the others occurring near Kendal.

Very abundant in the greenish quartzite (Upper Ludlow rock) of Benson Knot, Kendal, Westmoreland.

(Col. University of Cambridge.)

Pterinea asperula (M'Coy).

Sp. Char. Obliquely ovate, body of the shell evenly convex, abruptly defined from the anterior and posterior sides; beak gibbous; anterior wing rounded, less than half the length of the posterior wing, which is flat, acutely pointed and extending a little beyond the shell, its posterior margin concave; posterior end of the shell broadly rounded; entire surface radiated with nearly equal rough (obscurely tuberculated) ridges separated by flat spaces rather greater than their diameter in width (six ridges in one line at margin); these ridges are crossed on the body of the shell by fine wrinkles of growth which on the wing and towards the beak become sharp definite striæ parallel with the margin; width from beak to margin $2\frac{1}{2}$ lines, length from beak to posterior end $3\frac{1}{2}$ lines, width of posterior wing from angle to side of shell $1\frac{1}{2}$ line.

Common in the black shale of Builth Bridge, Radnorshire.

(Col. University of Cambridge.)

Pterinea hians (M'Coy).

Sp. Char. Rotundato-quadrate, slightly oblique, moderately gibbous, most so one-third the length from the beaks, which are one-third the length of the hinge-line from the anterior end; anterior side large, defined by a deep hollow extending nearly at right angles with the hinge-line from before the beak to the ventral margin, in which it produces a slight sinus; in front of this it is convex, and then nearer the slightly acute cardinal angle another smaller shallow sinus extends from the margin towards the beak; posterior wing broad, compressed, not abruptly defined from the body of the shell, slightly acute, and scarcely extending beyond the posterior end of the body of the shell which is obtusely rounded; ventral margin nearly horizontal, slightly convex; surface with close fine equal thread-like radiations, interrupted by slightly irregular concentric imbrications about half a line apart. Width from beak to middle of ventral margin $6\frac{1}{2}$ lines, length of hinge-line 9 lines.

This differs from the *Avicula emarciata* (Conrad) by the large gaping anterior side with its double sinus; the same separates it from a small variety of the *A. Boydii* (Conrad); it is also more square and less oblique than either of these species. The large size of the anterior lobe also separates it from the *Avicula quadrula* (Conrad).

From the Aymestry limestone of Mortimer's Cross, Aymestry. (Col. University of Cambridge.)

Pterinea megaloba (M'Coy).

Sp. Char. Obliquely subtrigonal, diagonally tumid from the beak to the posterior end (the curve amounting nearly to a semi-circle in old specimens); hinge-line elevated into a compressed, nearly rectangular, broad wing, the angle rather nearer to the beak than to the posterior ventral end, which is obtusely rounded, and to which the margin is nearly straight; anterior end short, forming a very large rounded lobe; a shallow concavity which defines it from the body of the shell extends from the beak to a little in front of the middle of the ventral margin, where it forms a small sinus; beaks narrow, prominent, incurved; anterior muscular impression very strong in the casts; no teeth. Width from beak to opposite ventral margin 7 lines, length from anterior to posterior ends 1 inch 1 line, width of posterior end 11 lines, depth of left valve 5 lines. Surface apparently smooth, or marked with fine concentric striæ.

The great size of the anterior lobe is the most remarkable character, and is produced by the byssiferous sinus *extending backwards* at an acute angle to the hinge-line (about 75°), unlike any other species I know. If it was not for the left valve being so much more convex than the right, the species might have been placed in *Cypricardites*; the general form is exactly that of the *Pterinea rectangularis* (Sow. sp.) Sil. Syst. t. 3. f. 2, from which it seems to differ (nine specimens examined) in the want of the diverging cardinal teeth.

Not uncommon in the tilestone of Storm Hill, Llandeilo. (Col. University of Cambridge.)

Pterinea Sowerbii (M'Coy).

Avicula reticulata (Sow.), S. S. t. 6. f. 3 (not of Hisinger nor Goldfuss).

Sp. Char. Obliquely ovate, depressed, slightly convex, greatest length along the posterior slope, which is straight and defined; posterior wing gently arched, scarcely extending beyond the shell, its posterior edge slightly and uniformly concave; surface radiated by slightly irregular obtuse ridges, about their

thickness apart, (five in 2 lines about the middle, at an inch from the beak,) partially interrupted by thin concentric imbrications from 1 to 2 lines wide, having the radiating ridges obsolete or nearly so on their half; radiating ridges of the wing rather larger, strongly marked only about the middle. Length from beak to respiratory* angle 2 inches 6 lines, length of posterior wing 1 inch 6 lines, width of ditto 1 inch 1 line, width from middle of hinge-line to ventral margin 2 inches 5 lines, depth of one valve 3 lines.

This fine species differs from the *Pterinea reticulata* of the original continental authors, in its more elongate form, smaller posterior wing, with its gently concave posterior edge, and the comparatively few, broad, thin imbrications interrupting the radiating ridges.

Aymestry limestone, Leintwardine.
(Col. University of Cambridge.)

Pterinea tenuistriata (M'Coy).

Sp. Char. Subquadrate, rounded, slightly oblique, evenly gibbous, left valve most so; width only slightly exceeding the length; beaks large, tumid; anterior wing half the length of posterior one, abruptly compressed, rounded; ventral margin and posterior end broadly rounded, posterior margin slightly concave towards the cardinal angle of the posterior wing, which is gradually compressed and scarcely extends beyond the shell; surface with irregular concentric wrinkles of growth crossed by very fine equal or subalternate radiating striæ from the beak, strongest in the middle, about six in 1 line, less than their diameter apart; posterior lateral tooth or hinge-plate as long as the hinge-line, and close beneath it, a thick internal ridge (often leaving a sulcus in casts) curves from behind the beak towards the ventral margin at an angle of about 50° to 60° from the hinge-line; hinge-line crenulated, forming Arca-like transverse teeth in front of the beak. Width from beak to opposite ventral margin 4 lines, length $4\frac{1}{2}$ lines.

This little species is much less transverse, and has a more obtuse posterior wing than the *Avicula insueta* (Conrad), which it otherwise much resembles. The abrupt bending-down of the curved internal ridge, like a lateral tooth, into the body of the shell, is a curious character, in which, as well as general form, it

* As the term *anal angle* is commonly used in speaking of the angle between the end of the hinge-line and the posterior margin, I propose using the term *respiratory angle* in the description for the angle between the posterior and ventral margins—the excretory or anal siphon being next the former, and the inhaling or respiratory siphon next the latter.

agrees with the *P. sublævis* (M'Coy) of the Irish Silurian rocks, but from which it is distinguished by its fine close striation.

Common in the Upper Ludlow shale of Cwm Craig Ddu; Middleton Park near Sedburgh; Erw Gillfach, and in the Ludlow schists above Parklane; Upper Ludlow rock of Benson Knot, Kendal, Westmoreland; also in the sandy schists of Pont-ar-yllechan.

(Col. University of Cambridge.)

CHAPTER X.*

MOUNTAIN LIMESTONE FOSSILS.

Cyathopsis? eruca (M'Coy).

Sp. Char. Corallum very small, subcylindrical after a diameter of 3 lines, which it reaches at 6 lines from the apex, slightly curved; length of large example 1 inch 2 lines, diameter $3\frac{1}{2}$ lines; surface marked with coarse, longitudinal, obtuse lamellar striæ, three in the space of 1 line; radiating lamellæ strong, slightly irregular, connected by several curved thick transverse vesicular plates in the horizontal section, one of the lamellæ stronger than the rest, and extending through the centre, where it is either thickened or confounded with a slight mesial boss of one of the transverse septa: *vertical section*, middle third traversed by thick, subregular, transverse diaphragms, convex upwardly, three interdiaphragmatal spaces in 1 line; outer third on each side formed of one or two rows of irregular large cells, formed by the junction and occasional duplicature of the deflected edges of the diaphragms.

This so exactly resembles the *Cyathaxonia cornu* in size, shape and general external appearance, that it might be very easily confounded with it; even externally, however, it might be distinguished by the smaller number in a given space of its much coarser lamellar vertical striæ; internally it is easily distinguished by wanting the solid styliiform axis, by the distinct transverse vesicular plates between the lamellæ in the horizontal section, and the transverse septation, &c. of the vertical section.

Very common in the black carboniferous limestone and shale of Beith, Ayrshire.

(Col. University of Cambridge.)

Caninia subibicina (M'Coy).

Sp. Char. Corallum much curved, increasing, when young, at the rate of 6 lines in 1 inch to a diameter of 1 inch 3 lines, after which it remains nearly cylindrical for 2 or 3 inches more; surface with a thin, nearly smooth epitheca, marked with obsolete transverse undulations of growth; when the

* The species in this chapter date from the 'Annals' for March 1851.

epitheca is removed, the very fine, equal, costal striæ are brought into view, five in 2 lines at a diameter of 1 inch 2 lines; the outer, small, vesicular area is rather more than a line wide, within which the sixty-five thick primary radiating lamellæ extend, about 4 lines towards the centre, leaving the broad, flat, smooth, slightly undulated central portion of the diaphragms about 6 lines in diameter in parts of the circumference; short secondary lamellæ appear one between each of the primary; lateral siphonal depressions strongly marked: *vertical section* shows the outer vesicular area (at about the above diameter) $1\frac{1}{2}$ line wide, composed of about four very oblique rows of small rounded cells, extending upwards and outwards, from the broad deflected edges of the diaphragms, which latter are thick, tolerably regular, nearly horizontal in the middle, about three interdiaphragmatal spaces in 2 lines.

This species is most nearly like Fischer de Waldheim's figure of his *Turbinolia* (*Caninia*) *ibicina*, from which it differs in the greater number of the lamellæ, &c. It differs from the *C. gigantea* in its smaller size, slender form, more regular and smoother surface, much finer cells of the narrow outer area. I suspect this may be the coral quoted occasionally by authors from mountain limestone, under the name of the Devonian *Cyathophyllum flexuosum*, to the figures of which it bears some resemblance in external form, but from which it differs in its greater size, coarser lamellar striæ, deflected edges to the diaphragms, &c.

Not uncommon in the carboniferous limestone of Kendal, Westmoreland.

(Col. University of Cambridge.)

Diphyphyllum gracile (M'Coy).

Sp. Char. Corallum forming large masses of cylindrical tubes 2 lines in diameter, dichotomously branching and occasionally coalescing laterally; surface marked with sharp longitudinal lamellar striæ, about four in 1 line: *vertical section* shows transverse, very slightly convex, thick, smooth, regular diaphragms reaching nearly across the tube, two interdiaphragmatal spaces in 1 line, bent downwards at the circumference; lateral vesicular area extremely narrow (less than one-fourth the diameter), of about one layer of cells: *horizontal section*, primary radiating lamellæ thick, equal, extending less than halfway to the centre, leaving the broad smooth diaphragms or clear space in the middle nearly two-thirds the diameter; between each pair of primary in some specimens is an extremely minute marginal lamella.

The small diameter of the tubes distinguishes this species

easily from any other *Diphyphyllum* I know, and gives the whole much the appearance of *Siphonodendron aggregatum* (M'Coy), but the lamellæ do not extend nearly to the centre ; there is no axis, and the dichotomous fission of the star and tubes may be distinctly observed.

Not uncommon in the impure limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Clisiophyllum turbinatum (M'Coy).

Sp. Char. Corallum simple, turbinate, very rapidly enlarging, attaining the adult diameter of about $1\frac{1}{2}$ inch at 2 inches from the point of attachment ; surface of the strong external wall or epitheca marked by coarse, numerous, imbricating transverse striæ, and a few larger inequalities of growth (no distinct longitudinal striæ except when abraded) : *horizontal section*, central area or axis nearly equalling one-half the diameter of the coral, composed of a close crumpling of fine vesicular plates, crossed by a few radiating irregular extensions of every fourth or fifth of the radiating lamellæ, one of which, stronger than the rest, is usually seen to cross the middle (forming a thick mesial line in the vertical section, and a prominent crest in the cup) ; lamelliferous axis rather less than one-third of the whole diameter, radiated by about fifty-four strong, equal lamellæ (at a diameter of 1 inch), connected by numerous delicate transverse vesicular plates ; four lamellæ in the space of 2 lines near the margin ; outer or perithecal area less than one-fourth the width of the lamelliferous zone, from which it is separated by a thin definite boundary ; it is composed of about two obscure rows of small, compressed cells, more or less crossed by costal extensions of the lamellæ : *vertical section* shows a strong, solid line down the middle of the axis or middle area, a thinner solid line defining the axis on each side, and a similar one between the middle and external areas ; external area very narrow, of about two rows of minute cells ; middle of about three rows of large rhomboidal cells formed of thin, moderately curved vesicular plates converging upwards and inwards at a low angle ; inner area composed on each side of about three rows of cells, converging upwards to the mesial line, much smaller and more compressed than those of the middle area : *terminal cup* of moderate depth, lined by the thick, equal, radiating lamellæ, the axis forming a moderately prominent boss in the bottom, crossed by a small prominent crestiform plate.

This is easily distinguished from the other known species by its short, rapidly expanding turbinate form ; it resembles

the *C. bipartitum* in the crest-like median plate on the boss or central area (axis), but differs in having the axis much smaller, the middle area much larger, the perithecæal area smaller, and the fewer lamellæ, besides the difference in shape. The *C. Keyserlingi*, like the last species, has short secondary lamellæ between the longer ones; it also differs from this in its very slender form, and wants the crest across the axial boss in the cup, but is otherwise nearly allied, although very distinct as a species.

Common in the carboniferous limestone of Beith, Ayrshire; rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Pteronites persulcatus (M'Coy).

Sp. Char. Transversely trigonal, right valve gently convex, left valve diagonally tumid, posterior end broad, rounded, flattened anterior end and beaks forming a small, convex, obtusely pointed extremity; a small space of the anterior extremity smooth, all the rest of the shell covered with small, coarse, rugged, flexuous, irregular ridges, for the most part alternately larger and smaller, and less than their thickness apart, those of the posterior wing nearly straight, radiating, those of the body arching downwards towards the ventral margin. Length of hinge 10 lines, greatest depth at right angles to the hinge $5\frac{1}{2}$ lines.

This species is distinguished from the *P. sulcatus* (M'Coy) and the *P. semisulcatus* (M'Coy) (of which latter it has the exact form) by having all the posterior part of the shell striated; in its ridging it agrees with the *Lanistes rugosus* (M'Coy, Synop. Carb. Foss. Ireland, t. 10. f. 8), but the above form, and broad beak and anterior end seem to separate the latter. It grows larger than the above measure.

Not uncommon both in the main limestone of Derbyshire and the black limestone resting on it: of large size in the impure limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

STREBLOPTERIA (M'Coy), n. g.

Etym. στρεβλὸς, *perversus*, and πτερόν, *ala*.

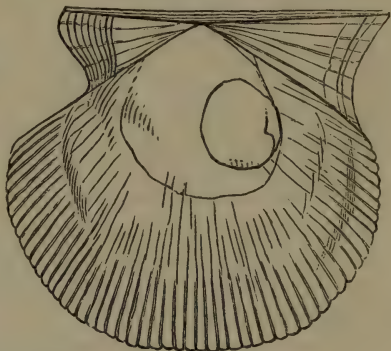
Gen. Char. Ovate or rounded, obliquely extended towards the anterior side; posterior wing broad, undefined, nearly rectangular, extending nearly as far as the posterior margin of the shell; anterior ear small, deeply defined; surface smooth or radiatingly ridged; one large, faintly marked muscular impression a little behind the middle; one short, narrow tooth slightly diverging from the hinge-line on the posterior sides

of the beaks ; ligament confined to a narrow simple facet on the hinge-margin.

These shells differ from some of the short-winged group of *Avicula* (or *Pteria*), to which they are most allied, by the obliquity of the body of the shell being towards the anterior instead of the posterior side—the reverse, in fact, of what occurs in nearly all shells except the *Limæ*. There are many species in the carboniferous limestone, to which formation the genus seems at present confined, unless the *Pterinea posidoniaformis* (M'Coy), (Syn. Sil. Foss. of Ireland, t. 2. f. 10) of the Upper Silurian strata belongs to it.

AVICULOPECTEN (M'Coy), n. g.

Gen. Char. Inequivalve, more or less inequilateral, straight, or slightly extended obliquely towards the posterior side ; anterior ear flattened, smaller than the posterior, sharply and deeply defined, with a deep notch in the right valve between it and the body of the shell for the passage of the byssus ; posterior ear slightly pointed, extending about as far as the margin of the shell, defined or not ; ligament and cartilage confined to a narrow facet along the hinge-margin, no medial cartilage-pit ; muscular impression and pallial scar as in *Pecten*.



Internal cast of *Aviculopecten*.

It was only on seeing the fine suite of fossils from the dark limestone of Lowick, Northumberland, recently presented by the Rev. Mr. Jenkins to Prof. Sedgwick, and now in the collection of the University of Cambridge, that I recognized the characters by which the great bulk of the so-called *Pecten*s of the middle and upper palæozoic rocks are distinguished from the true *Pecten*s of the more recent formations and present sea. In the present fossils the *posterior* ear is largest, thus differing in an external character from *Pecten* and approaching *Avicula*, an affinity greatly increased by the internal structure exposed by the Lowick (and some Irish) specimens, showing that there is no mesial ligamentary pit beneath the beak as in the former genus, but, as in the latter, the ligament is confined to the hinge-margin, while in general form and little or no obliquity of the shell the resemblance of the species to *Pecten* is so very striking that most

writers agree in placing them in that genus. The discovery of this character fixes the zoological place of numerous carboniferous shells constantly varying hitherto in the systems between *Pecten*, *Avicula* and *Meleagrina*.

Aviculopecten plano-radiatus (M'Coy).

Sp. Char. Ovate, apical angle 80° in young specimens, 95° in adults from an upward curve of the anterior side, length and width nearly equal, gently convex; beaks small, prominent; ears very deeply defined from the body of the shell by a narrow very steeply inclined plane, left anterior one rotundato-quadrate, obscurely radiated, posterior ones longer, falcately pointed, radiated by a few slender ridges crossed by the lines of growth; surface radiated with numerous ribs (thirty to forty at $1\frac{1}{2}$ inch from beak) which are smooth, broad, flat, more or less irregular in width, and separated by a very narrow impressed line towards the margin and body of the shell, but nearer the beak they are sharp, narrow and alternately larger and smaller; the ears are sharply striated, parallel with the margin, and have a few narrow distinct radiating ridges. Width from $1\frac{1}{2}$ to nearly 4 inches.

The radiations vary from $1\frac{1}{2}$ line to $\frac{1}{2}$ a line wide in different specimens at the margin. This species differs from the *P. planicostatus* (M'Coy) in its being oblique and the much greater number of its ribs.

Common in the carboniferous limestone of Derbyshire.
(Col. University of Cambridge.)

Aviculopecten Ruthveni (M'Coy).

Sp. Char. Suborbicular; apical angle about 110° in the adult, from the upward curve of the sides, only 85° in the young; length slightly exceeding the width, tumid; surface radiated by about fifteen thick, rugged ridges, between each pair of which are usually three smaller ridges, each pair separated by a concave space about equal to the thickness of the ridges; ears large, the posterior one broad, extending as far as the margin of the shell, with three or four distant radiating ridges crossed by coarse lines parallel with the concave extremity; anterior ear similar, but slightly smaller, both defined. Width from beak to opposite margin about 2 inches, length (at right angles to the width) about the same.

Fragments of this species bear some resemblance to portions of the *Pecten*? *quinquelineatus* (M'Coy), but it is distinguished by the much less number of the ridges, &c. I have dedicated it

to Mr. John Ruthven of Kendal, the well-known enthusiastic collector of palæozoic fossils.

Rare in the impure carboniferous limestone of Dent, and one small specimen from the similar limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Sanguinolites clava (M'Coy).

Sp. Char. Elongate, claviform, three times longer than wide, anterior end large, obtusely rounded, dorsal and ventral margin with a slight upward curvature, no byssal furrow; posterior end slightly narrowed, subtruncate, rounded; beaks large, obtuse, a broad ovate striated lunette beneath them on the anterior side; posterior lunette, the largest of the hinge-line, wide, hollow, bounded by the obtuse ridges of the dorsal margins; valves very convex in front, their depth beneath the beaks five-sixths of the width from them to the ventral margin, gradually becoming more compressed towards the posterior end, where the depth is only half the width; posterior slope gently convex, undefined, diagonal ridge not marked; surface covered with thick, rugged, subequal ridges, arising a little behind the anterior lunette, and slightly thickening towards the posterior slope, which is defined by their termination, and only marked by fine striæ of growth parallel with the end; anterior lunette and a small portion of the anterior extremity also nearly smooth; the ridges, where the outer surface is preserved, are covered with a minute irregular striation approximately parallel with the margin. Length from anterior to posterior end about 5 inches 2 lines, width from beak to opposite ventral margin 1 inch 11 lines, depth of both valves 1 inch 9 or 10 lines.

This fine species is remarkable for the clavate form produced by the gibbosity of the valves near the anterior end and the tapering towards the posterior extremity. Of the internal impressions I have only seen the anterior adductor, which is broad, rounded, and shallow. The only approximation to this species published that I know is an imperfect fragment of one end of a shell called *S. maxima* by Portlock, Geol. Rep. t. 36. f. 1, which is flatter with smaller beaks, a more truncate anterior end, &c.

Not uncommon in the carboniferous limestone near Llangollen, North Wales.

(Col. University of Cambridge.)

Sanguinolites subcarinatus (M'Coy).

Sp. Char. Elongate oblong, tumid; beaks very large, obtuse,

near the small, rounded, anterior end, in which there is an abruptly hollowed space beneath the beaks; posterior end narrow, square, truncated; diagonal ridge angular, slightly sigmoid, strongly defined from the beak to the respiratory angle; posterior slope smooth, slightly concave; sides slightly flattened, with coarse irregular striæ and irregularities of growth parallel with the margin; ventral margin nearly straight; hinge-line as long as the shell, its inflected margins broad, slightly concave, nearly at right angles to the plane of the margin of the valves; cardinal ridge thick, obtuse, diverging nearly half the width of the posterior slope from the hinge-line. Length 1 inch 4 lines, proportional width from beak $\frac{4.5}{100}$, width at posterior end $\frac{2.6}{100}$, length of anterior end $\frac{1.0}{100}$, depth of one valve (greatest about the middle of the diagonal ridge) $\frac{1.5}{100}$.

This rare species is remarkable for its narrow square posterior end and strong angular diagonal ridge. It is proportionally shorter and less regularly ridged than the *S. angustatus* (Phill.). Goldfuss's figure under this latter name nearly agrees with our shell and is no doubt identical.

In the impure carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Sanguinolites variabilis (M'Coy).

Sp. Char. Oblong, tumid, nearly closed at the ends; averaging twice as long as wide (sometimes a little more, sometimes a little less); beaks large, tumid, oblique, close to the anterior end, which varies from one-ninth in large, to one-seventh of the length in smaller specimens; anterior lunette large, smooth, oval, contracting the round anterior end; ventral margin nearly straight, or commonly with a wide shallow sinus, very rarely with a slight convexity; valves evenly tumid or with a slight broad mesial concavity or flattening; posterior slope flattened, smooth, defined by a diagonal slightly sigmoid ridge, sharp and angulated near the beak, gradually becoming rounded and obscure towards the inferior posterior (respiratory) angle in old specimens; greatest depth of the valves along this line and about half-way from the beak; hinge-line with a slight upward curvature, posterior lunette very wide, concave, nearly horizontal; surface marked by concentric wrinkles, variable in size and strength, usually thickening slightly on reaching the diagonal posterior ridge, almost always undulated and irregularly interrupted about the middle and anterior third of the sides (averaging five or six in the space of 3 lines from the

beak, about the middle of the shell); periostraca sharply marked with close interrupted striæ and a few minute scattered points, very rarely falling into close regular radiating lines; usual width 9 lines, length 1 inch 3 lines, greatest depth (a little behind the middle) 7 lines (occasionally 2 inches long).

The irregular interruption and undulation of the concentric wrinkles in front of the middle of the sides is often very striking and beautiful and is always recognizable. It is very variable in the thickness and regularity of the ridges; it most nearly approaches the *S. regularis* (King sp.), from which it differs in the undulatory interruption of the ridges at the place mentioned, and in being shorter, and the greatest gibbosity of the shell being along the anterior boundary of the posterior slope—it being much nearer the anterior end, and the posterior portion being compressed in that species, in which also the greatest gibbosity is nearer to the dorsal margin, giving a much less tumid character to the lower part of the valves. From the *S. sulcatus* it differs in the wrinkles not uniting into few large wrinkles in passing to the posterior slope, &c.

Rare in the carboniferous limestone of the Isle of Man; not uncommon at Lowick, Northumberland.

(Col. University of Cambridge.)

Leptodomus costellatus (M'Coy).

Sp. Char. Oblong, very tumid, width three-fifths of the length, depth of both valves about equal to the width; anterior and posterior lunettes large, defined; beaks large, tumid, incurved, terminal, anterior side obtuse, subtruncate, slightly oblique beneath them; a small sinus in the ventral margin close to the anterior end, from which a narrow concavity extends nearly to the beaks close to the anterior edge; hinge-line nearly as long as the shell, with a slight upward curvature; posterior end wide, slightly oblique, subtruncate, rounded; ventral margin strongly convex behind the sinus; posterior slope abruptly compressed, smooth, or with a few lines of growth parallel with the margin, divided nearly in the middle by a small furrow from behind the beaks; sides marked with numerous small, regular, close, narrow, rounded ribs parallel with the margin (about four in the space of 2 lines); these abruptly disappear on reaching the edge of the posterior slope, and unite on the anterior edge in front of the sinus in parcels of two or three to form a row of short thick wrinkles on that part. Length 1 inch 4 lines, width 10 lines, depth 10 lines, width of posterior lunette $1\frac{1}{2}$ line.

I long imagined this to be the *Hiatella sulcata* of Fleming,

but it seems Dr. Fleming agrees with Prof. Phillips as to that being identical with the *Sanguinolaria sulcata* of the latter. The present species differs from the *Sanguinolites sulcatus* (Phill. sp.) in its thin shell, short inflated form, want of the thick internal cardinal ridges, the more regular sharp ribs on the sides, and their uniting into large wrinkles on the anterior instead of the posterior end.

Common in the carboniferous shales of Craige near Kilmar-nock; carboniferous shales near Glasgow; in the shaly beds of Lowick, Northumberland.

(Col. University of Cambridge.)

CHAPTER XI.*

CAMBRO-SILURIAN FOSSILS.

Cytheropsis Aldensis (M'Coy).

Sp. Char. Arcuato-oblong, dorsal margin much arched, greatest convexity about the middle, sloping more towards the anterior, which is slightly smaller than the posterior end; posterior end broadly arched, anterior end obtusely pointed; a concave flattened sinus rather more than half the length of the shell in the ventral margin, rather nearer to the anterior than the posterior end; an obscure roughened spot slightly nearer to the anterior than the posterior end, and slightly nearer to the dorsal than the ventral margin; valves moderately and evenly gibbous; surface very minutely punctured under a strong lens. Length $1\frac{1}{2}$ millimetre, depth about $\frac{2}{3}$ rds the length.

This little species is accompanied by a more elongate, oblong, less arched form of greater rarity, which may either be a distinct species or the male.

Extremely abundant in the dark earthy limestone of Aldens, Ayrshire.

(Col. University of Cambridge.)

Harpes parvulus (M'Coy).

Sp. Char. Cephalic shield semielliptical; flattened limb very wide (slightly exceeding the length of the glabella in front) with a thick margin; glabella narrow cylindrical, the slightly narrowed front about the width of its base, within the front margin of the cheeks; cheeks convex, one-third wider than the glabella at base; oculiform tubercles on a line with the anterior margin of the glabella, and slightly nearer to it than to the lateral margins; surface minutely granulated. Length of cephalic shield 3 lines, proportional length of front margin about $\frac{4.8}{100}$, length of glabella $\frac{4.6}{100}$.

This little *Harpes* is interesting as the first occurrence of the genus in Silurian rocks in Britain, although Col. Portlock has described two species which are common in Ireland. The species is remarkable for its small size and extremely wide marginal plate.

Limestone of Wrae quarry, Upper Tweed.

(Col. University of Cambridge.)

* The species in this chapter date from the 'Annals' for Nov. 1851.

Pseudocrania (M'Coy), n. g.

Gen. Char. Shell slightly inequivalve, free, both valves regularly depressed, subconical, unattached; dorsal valve with or without a small cardinal area; internally, margin broad, flat, smooth or minutely striated concentrically, anterior pair of muscular impressions much larger and more strongly marked than the posterior pair; pallial impressions numerous, linear, not interrupted along the middle.

This palæozoic genus differs from the true *Crania* in the following points: 1st, *Crania* is attached by the substance of the dorsal valve, and exhibits thereon an irregular scar; both valves are free and regular in *Pseudocrania*; 2nd, in *Crania* the posterior or marginal pair of adductor muscles are always larger and deeper than the medial or anterior pair; the reverse is remarkably the case in the present genus, which also has a smooth or minutely striated margin, destitute of the strong granulation and punctures of most *Crania*. The *Crania antiquissima* as given by Verneuil may be taken as the type of the genus, as also the following species.

Pseudocrania divaricata (M'Coy).

Sp. Char. Longitudinally oblong, length and width almost equal, slightly narrowed posteriorly; hinge-line straight, a little shorter than the width of the shell; dorsal valve (analogue of the lower or attached valve) with a very low triangular cardinal area; external surface ornamented with sharp, prominent, narrow rugged lines divaricating from the beaks, those of the sides arched backwards towards the cardinal angles, about equally distant throughout from the intercalation of shorter striæ as the longer approach the margin, intervening spaces flat, about four ridges in the space of one line; internal casts show a broad, flat, defined rim with minute irregular concentric striæ, and the following parts in relief (depressions in the shell): 1st, a small oval mesial space originating near the hinge, and reaching to one-fourth of the length; 2nd, on each side of this, close to the hinge-margin, are two diverging oval muscular impressions; 3rd, at a little behind the middle of the shell are two ovate subtrigonal anterior muscular impressions considerably larger and deeper than the posterior pair; 4th, close in front of those a narrow semicircular impression (scar of visceral aponeurosis?) with its extremities arching backwards round the muscular impressions; 5th, between this and the front and lateral margin, a series of from fifteen to twenty-two uninterrupted equidistant longitudinally narrow pitted (? pallial) marks, each dividing at its anterior half,

separated by rather wider smoother spaces. Length 10 lines, greatest width (a little in front of the middle) $10\frac{1}{3}$ lines, height of cardinal area three-fourths of a line.

In size and general character this agrees with the *Pseudocrania antiquissima* (Eichw. sp.) as given by M. de Verneuil (Geol. Russ. t. 1. fig. 12), but is easily distinguished externally by the beak being close to the posterior margin, and the remarkable divaricating sculpture of the valves, and internally by several minor points of detail obvious on comparison with the figure.

Common in the schists on the Bala limestone at Bryn Melyn quarry; schists of Pont y Glyn, Diffwys; and in the fine grits of Tan y Craig, Builth.

(Col. University of Cambridge.)

Siphonotreta micula (M'Coy).

Sp. Char. Longitudinally ovate, length and width about equal; sides and front broadly rounded, with a uniform curve, posterior extremity slightly acuminate; gently convex, perforated valve most so; greatest depth about one-fourth the length from the beak, which is near the posterior margin, and perforated by a round tubular opening; surface marked with a few concentric waves of growth, and sharp, flat, regular concentric linear striæ, about seventeen in the space of one millimetre; several short, slender, conical spines are rather irregularly scattered over the surface, the substance of the shell exhibiting under a high power an extremely minute reticular punctation. Average length (of rather large specimen) 2 lines, width usually rather less.

This small species varies from nearly orbicular to ovato-pentagonal in outline; in some specimens, particularly those from Wellfield, the depressions left by the spines of the surface are very obvious and rather crowded, producing a puckered irregularity of the surface, which is not to be seen in most of the specimens from Pen Cerrig; the concentric lineation is also more distinct in the former, between which the reticular punctation is so excessively minute, that it can only be traced with very fine and powerful glasses in favourable lights on the best-preserved portions of the shell, differing therefore very much from the most nearly allied fossil, the so-called *Terebratula hamifera* of Barande. In nearly all the specimens the distinct and rather large circular opening at the apex of the beak is easily seen, and in many specimens an irregular fissure, apparently produced by crushing, extends a variable distance towards the front margin, either in the median line or more or less to one side or the other. The few rather large concentric waves or interruptions of growth are only seen in some specimens.

This species seems to agree in everything with the little *Terebratula hamifera* (Bar.) (Haidinger's *Naturwissenschaftliche Abhandlungen*, vol. i. p. 418. t. 20. f. 9), but has the reticular punctation infinitely more minute than he describes that of his species to be (half a millimetre long, or four in a square millimetre). M. Barrande gives the geological place of his species in Bohemia as "gehört der Quartzeitage (D) an d. h. dem am höchsten gelegenen Theile des untern Silurischen Systems von Böhmen," and the schists in which ours occurs in such profusion in Britain seem to hold precisely the same place. Its gregarious habits are curiously shown by the circumstance of a fragment of shale four or five inches long and wide from Pen Cerrig having afforded upwards of 100 specimens now in the Cambridge collection, and another mass not much larger from Wellfield having yielded upwards of 70.

Very common in certain spots in the black shale of Pen Cerrig, Builth, Radnorshire; and not uncommon in the olive schists of Wellfield, Builth, Radnorshire; very rare in the olive schists of Pentre Llangynyw near Welchpool, Montgomeryshire.

(Col. University of Cambridge.)

Pentamerus microcamerus (M'Coy).

Ref. & Syn. *Spirifer? laevis*, Sow. S. S. t. 21. f. 12 (not *Pentamerus laevis*, Sow.).

Sp. Char. Transversely elliptical; receiving valve depressed, gently convex, greatest depth near the beak, which is elevated nearly at right angles, the height being one-eighth the width of the hinge; entering valve greatly convex; beaks small, rather prominent, reaching to the plane of the lateral margins, with which the low triangular area is nearly parallel, greatest depth slightly behind the middle; a broad, faintly marked, slightly convex, obsolete mesial ridge, and a few faint, broad, obsolete, irregular lateral radiations; hinge-line slightly less than the width of the shell, side margins elliptically rounded, front margins very wide, gently convex; cardinal area nearly sixteen times wider than high; surface apparently smooth, or with a very minute fibrous longitudinal striation: internal cast of receiving valve showing the broad triangular boss of the foramen, slightly keeled, the mesial septum formed by the junction of its bounding lateral lamellæ, only reaching one-third the length of the shell, or little more than equal to the width of the rostral chamber; cast of entering valve with a very narrow triangular area in the plane of the lateral margins; two very slightly diverging dental lamellæ, scarcely reaching twice the width of the area (or one-eighth the length of the shell), the exterior edges of which form two more diverging slits, resem-

bling cardinal teeth ; a slight indication of a mesial septum commencing a little in front of the ends of the diverging lamellæ, from between the ends of which project two long spatulate muscular impressions, not reaching quite to the middle of the shell. Width 2 inches 6 lines, proportional length $\frac{5.5}{100}$, depth of receiving valve $\frac{1.2}{100}$, of entering valve about the same.

I have recently examined such a great number of specimens from May Hill, that there can no longer be any doubt that it belongs, not to the genus *Spirifer* as suggested by Sowerby, nor to the genus *Orthis* as suggested by other palæontologists, but is a distinctly defined species of *Pentamerus*, distinguished by the very small size of the rostral chamber in the receiving valve, and the extreme shortness of the diverging lamellæ in the entering valve, which are not even indicated in Mr. Sowerby's figure thereof. As the species must be placed in the genus *Pentamerus*, and there is already a *Pentamerus lævis*, I am obliged to propose a new specific name. In very young specimens 3 lines long the mesial septum exceeds half the length of the shell.

In the fine sandstone of Mandinam, Caermarthenshire ; very abundant in the sandstone of May Hill, Gloucestershire.

(Col. University of Cambridge.)

Hemithyris angustifrons (M'Coy).

Sp. Char. Elongate ovate ; both valves very gibbous in the middle, gradually sloping to the margins, which are nearly level, or with a very slight elevation of the front towards the entering* valve ; greatest width in most specimens rather behind the middle, from whence the width diminishes to the narrow obtusely rounded front ; beak of the receiving valve large, pointed, with a very long triangular opening beneath it ; substance of the shell coarsely fibrous, surface nearly smooth or with irregular transverse squamæ of growth ; casts show in the entering valve two subparallel approximate longitudinal sulci marking the inner edge of the muscular impressions, and with a fainter sulcus between them left by the slight mesial septum ; two pits near the beak, left by the apophyses, strong ; receiving valve with two strong dental lamellæ, one on each side of the beak, and a slight indication of a mesial septum ;

* As the terms "dorsal and ventral valves" have been almost invariably misapplied by conchological writers in describing Brachiopods, and as the confusion is very great when we use these terms in accordance with their anatomical position (but contrary to common use), I propose to use "receiving valve" for the perforated valve of *Terebratula*, &c. (called "dorsal valve" by conchologists and "ventral valve" by anatomists), and I use "entering valve" for the opposite one, of which the beak enters the cavity of the receiving valve.

few straight, once- or twice-branched impressions of the pallial vessels on each side. Length 9 lines, proportional length of entering valve $\frac{8.5}{100}$, width $\frac{7.5}{100}$, depth of both valves $\frac{5.0}{100}$.

The general ovate form of this species, with its narrow front, without mesial ridge or sinus, and its pointed beak, with large foramen, easily distinguish it from any of the other Lower Palæozoic forms. It varies considerably in depth, being sometimes rather less than the above dimensions, and having in one specimen the proportion of $\frac{7.0}{100}$, compared with the length; the width is sometimes a little more and sometimes a little less than the measurement given above. Some specimens seem to show projecting irregular transverse squamæ of growth.

Occurs in great number in the greenish sandstone of Mullock quarry, Dalquorhan, near Girvan, Ayrshire.

(Col. University of Cambridge.)

Hemithyris Davidsoni (McCoy).

Ref. & Syn. *Terebratula spherica* (David.), Bull. de la Soc. Géol. de France, 2nd S. vol. v. t. 3. f. 36 (not of Sow. S. S. nor Sow. Geol. Trans.).

Sp. Char. Globose or subcuboidal; entering valve deeper than the receiving one, moderately convex on the rostral half, abruptly and obtusely bent over towards the margin, nearly at right angles; beak of the receiving valve small, with a minute triangular opening beneath the apex, moderately convex, depressed towards the margin to form a broad, slightly defined sinus, the corresponding ridge to which in the entering valve is scarcely elevated; lateral margins nearly straight, front margin elevated into a quadrate sinus twice as wide as high; valves radiated with from eighteen to twenty very obtusely angular simple ridges, reaching distinctly to the beak, and sharply notching the margin, the four middle ones perceptibly larger than the rest. Length and width equal, and about 5 lines, depth of deflected front $\frac{5.5}{100}$, depth of both valves $\frac{8.8}{100}$.

This species differs from the *Terebratula spherica* (Sow.), Sil. Syst., by having the elevation of the front towards the entering valve as in ordinary cases, instead of towards the receiving one as in that species, which in consequence of this Mr. Davidson suggests to be a variety of *H. deflexa*; and the Devonian *Atrypa spherica* (Sow.), to which the present fossil is referred by Mr. Davidson, differs completely by having all the rostral portion smooth, while the ridges extend clearly to the beak in this Silurian type. The general form slightly recalls that of the *H. Wilsoni*, but there are much fewer ribs, and they are not divided by a medial sulcus on the deflected front.

Very rare in the Upper Ludlow rock of Burton and Brockton near Wenlock.

(Col. University of Cambridge.)

Hemithyris nasuta (M'Coy).

Sp. Char. Longitudinally ovate, longer than wide, gibbous, entering valve much deeper than the receiving one; receiving valve with a small obtuse beak, incurved nearly to touch the beak of the entering valve, with a small triangular perforation beneath; rostral portion tumid for about 5 lines from the beak, beyond which a wide flattened mesial depression is developed, gradually deepening towards the front, which in old specimens is very much produced into a flat tongue-shaped lobe, nearly as long as wide, gently sloping to the level of the most convex part of the entering valve; sides obtusely defined from the mesial furrow, gently convex, lateral margins slightly sigmoid, and bent upwards at the front, at a rounded angle of about 100° : entering valve with a slightly prominent beak; rostral portion and sides gently convex, after about 5 lines from the beak the middle is prolonged nearly in a straight line to the produced front margin, forming a large obtusely rounded mesial ridge: surface radiated with simple, close, obtusely rounded ribs, about four of which, rather larger than the rest, are raised with the mesial furrow, the broad sides of which are smooth, each side with about twelve slightly smaller ribs (seven in two lines at six lines from the beak near the side of the mesial furrow), leaving a rather broad smooth space at the rostral lateral margin on each side (a fine longitudinal striation is seen in some places). Length 1 inch 2 lines, proportional length of entering valve $\frac{90}{100}$, greatest width, about the middle of the length, $\frac{88}{100}$, greatest depth of both valves (one-third from the beak) $\frac{57}{100}$.

In form this species much resembles the *Terebratula promontorium* of Kutorga from the Lower Silurian limestones of Pulkowa (see Verhandlungen der Russ. Kais. Min. Gesellschaft zu St. Petersburg for 1845, t. 6. f. 3), but is distinguished by its ribbed surface.

Not uncommon in the schistose limestone of Craig Head near Girvan, Ayrshire.

(Col. University of Cambridge.)

Hemithyris sphaeroidalis (M'Coy).

Sp. Char. Suborbicular, gibbous, nearly equivalve, margins very obtuse from the inflection of the edges; lateral margins nearly level, front margin abruptly raised into a quadrate sinus, about twice as wide as long; receiving valve with a very

small pointed slightly incurved beak, with a minute triangular perforation beneath it, evenly gibbous except close to the sinus in the front margin, where there is a very slightly marked depression; entering valve evenly gibbous, with a very slightly marked, broad square ridge, extending a short way from the margin of the sinus; both valves radiated with from twenty to twenty-four very obtuse, rounded ribs, becoming gradually obsolete near the beaks, leaving the rostral portion nearly smooth, four of the ribs rather larger than the rest, slightly elevated with the mesial sinus; a short mesial septum in the entering valve; substance of the shell densely fibrous. Length 5 lines, proportional width $\frac{9.5}{100}$, proportional depth of both valves $\frac{7.0}{100}$.

The depressed spheroidal form and very obtusely rounded ribs becoming obsolete towards the beak, distinguish this species from the *H. nucula*, and the elevation of the mesial sinus being towards the entering instead of the receiving valve, as well as more depressed form, distinguish it from the *Terebratula sphaerica* and *Terebratula deflexa* of the Wenlock rocks, to which it is otherwise very similar.

This seems to be the Upper Silurian species referred to by Mr. Davidson as identical with the Devonian *Atrypa sphaerica* of Sowerby, to which it is very strongly allied, but is more depressed, has only four mesial ribs, and the beak is not adpressed. The obtuseness of the plaits and smooth rostral portion separate it from the *Terebratula pusilla* (Sow.) of the Lower Silurian rocks. The very obtuse margin, and smaller number of mesial plaits, and obtuse inflated form separate it from the *Terebratula famula* of Barrande (see Haidinger, Naturwissenschaftliche Abhandlungen, Band i. t. 17. f. 6).

Not uncommon in the Wenlock limestone of Dudley; Ireleth, Lancashire; Wenlock limestone of Ledbury, Herefordshire; and the limestone of the Hollies Church, Stretton.

(Col. University of Cambridge.)

Hemithyris subundata (M'Coy).

Sp. Char. Transversely broad, oval; valves gently and almost equally convex; beaks very small, apical angle 140° near the apex, lateral margins straight, front raised into a rounded wave, from which, in the large valve, a wide shallow mesial depression extends halfway to the beak, with a corresponding elevation in the small valve, in some specimens faintly extended to the beak: surface smooth. Average width 1 inch, proportional length $\frac{8.6}{100}$, length of entering valve $\frac{8.5}{100}$, depth of both valves $\frac{4.3}{100}$ to $\frac{5.0}{100}$.

This species is flatter and less wide than the *Atrypa* (*Pentamerus*) *undata* (Sow.), but less long than the *Atrypa* (*Pentamerus*) *lens*, being intermediate in form between the two. The casts show, however, in the small valve a rather strong slit in the beak for the short medial septum, and a transverse pit on each side for the origin of the apophyses or hinge-teeth. The receiving valve has two short diverging dental lamellæ, bordering its beak as in *Hemithyris* generally, with one or two small ridges between them; the sides of both valves show about three straight once- or twice-branched ridges of the pallial and ovarian vessels.

Very common in the schists and limestone of Mathyrafal S. of Meifod, Montgomeryshire; and in the schists of Pen y Craig, Llangynyw, Montgomeryshire; slate of Alt ffair ffynnon, Llanfyllin, North Wales.

(Col. University of Cambridge.)

Orthis Hirnantensis (M'Coy).

Sp. Char. Truncato-orbicular, depressed; cardinal area very low, triangular, nearly twelve times wider than high; hinge-line slightly less than the width of the shell; cardinal angles slightly obtuse, lateral and front margins horizontal, almost uniformly curved; entering valve perfectly flat, with a slight longitudinal mesial depression near the beak; receiving valve slightly and gently convex, most so along the middle, at about one-third the length from the beak; both valves with numerous slightly unequal, prominent, angular, strongly fasciculated striæ, each of the primary ridges branching near the middle into from five to seven smaller, forming in some specimens slightly angulated, divaricatingly arched groups, eight or ten striæ at the cardinal angles smaller and straighter than the rest, running nearly parallel with the hinge-line; separating sulci narrow, marked with very coarse punctures or little pits, and crossed by coarse obtuse transverse striæ; twelve to fourteen striæ in two lines at four lines from the beak; internal cast of receiving valve radiated with coarsely punctured impressions of the external striæ; cardinal teeth very short, thick, diverging at 80° . Width 1 inch, proportional length $\frac{70}{100}$, depth $\frac{16}{100}$.

This is an extremely beautiful species, remarkable for its flatness and broad divaricating bands of coarse, branched striæ, which are not at all arched along the hinge-line, as in the somewhat similar *O. retrorsistria* (in which the depth is greater, the striæ much more uniform, and the surface smoother, and the internal casts quite different).

Very abundant in the oolitic limestone and decomposing

schists over the Bala limestone at Aber Hirnant E. of Bala, North Wales; and in the similar limestone of Cwm yr Aethen; oolitic limestone of Maes y fallen, Bala, Merionethshire: rare in the limestone of Cerrig y Druidion, Denbighshire.

(Col. University of Cambridge.)

Orthis retrorsistria (M'Coy).

Sp. Char. Rotundato-quadrate, depressed, no mesial ridge or furrow in either valve; hinge-line nearly or quite as wide as the shell; cardinal angles slightly obtuse; cardinal area flat, triangular, six or seven times wider than high in the receiving valve, and inclined backwards at about 120° , only one-third this height in the entering valve; rostral tooth of entering valve very large, triangular foramen of receiving valve with an internal, semiconical, hood-shaped extension of the dental lamellæ within it; receiving valve gently convex, greatest depth about the middle of the length; entering valve flat round the margins, gently concave in the middle; both valves with a few concentric wrinkles of growth, about a line apart, and radiated with slightly irregular obtuse striæ, which branch into two or three, at two or three intervals between the beak and margin, so that each of the strong primary ones form from seven to ten at the margin, separated by a rather deeper sulcus from the adjoining ones, so as to produce a flat, indistinctly marked, fasciculation; intervening sulci about the same size as the striæ (obscurely punctured in some specimens), which are straight in the middle, gradually assuming a divaricating curve on the sides, which is so great near the angles, that a large number of the lateral striæ curve backwards from the beaks to terminate along the distal half of each side of the hinge-line instead of the lateral margin, all the striæ crossed by indistinct transverse lines of growth; the size of the striæ does not vary much in the various parts of the shell, from fourteen to seventeen may be counted in two lines at four lines from the beak; cast of entering valve nearly smooth except at the margin, which, in the middle, is marked with close slightly dichotomous lines; the narrow triangular boss of the foramen is cleft by a deep, narrow, elliptical pit of the rostral tooth, flanked by the pits of two short cardinal teeth, diverging at 70° , between which and the hinge-line are the smaller but more diverging bosses left by the cardinal pits; a deep straight sulcus extends from the rostral tooth nearly to the anterior margin, marking a very long obtuse mesial ridge, on each side of the rostral part of which is a subquadrate pair of muscular impressions reaching less than half the length of the shell, the length and width of the pair being nearly equal; the lateral boundaries

are formed by the deep impressions of a sigmoidal ridge, extending from the cardinal teeth on each side, each impression being slightly divided into two unequal lobes, anteriorly by the slight projection of an oblique narrow portion diverging from the anterior lateral angles; in fine specimens a faint transverse arched furrow separates the small posterior adductor impressions, which are longitudinally wrinkled, from the smoother and larger anterior portion; interior of receiving valve with two short cardinal teeth, diverging at 105° , from which two extremely long, narrow, elliptical muscular impressions extend more than half or nearly two-thirds the length of the shell, each lobe marked with faint radiating sulci, the pair being separated by a flat, acutely angular space, a little wider than one of the impressions at the anterior end, and extending to the point of the beak; a narrow space of the margin finely plicated, the rest of the surface nearly smooth or very faintly radiated. Width 10 lines, proportional length of receiving valve $\frac{9.0}{10.0}$, of entering valve $\frac{8.2}{10.0}$, depth $\frac{1.5}{10.0}$.

The backward curving of many of the lateral striæ to terminate on the hinge-line is more remarkable in this species than any other I know of, and suggests the specific name; something of the same sort may be seen in a less degree in the *O. subquadrata* (Hall), and one of the shells figured in the Mem. Geol. Surv. (vol. ii. pt. 1. t. 27. f. 9) as the *O. testudinaria*, from both of which the great general depression, the total absence of mesial fold, the concavity of the entering valve, great length of the narrow diverging muscular impressions in the receiving valve, &c., easily distinguish the present species. The same characters and backward curving of the lateral striæ separate it from the *O. protensa*.

Occurs in extraordinary profusion in the flags of S. end of Pen y gaer near Cerrig y Druidion, Holyhead Road, Denbighshire, closely covering extensive surfaces of the beds; flags at Hafod Evan, Penmachno, Caernarvonshire; schists of Cefn y coed, Llangedwyn, Montgomeryshire; schists W. side of Garn Brys, S.W. of Cernioge; abundant in the schists of Bwlch, Llandrillo, Corwen, N. Wales; schists of Llanwddyn E. of the Berwyn Mountains; schists of Das Eithin Ridge, Hirnant, Montgomeryshire; schists of Pen Cerrig Serth, Builth, Radnorshire; schists of Miltit Cerrig, Llangynnog, Montgomeryshire; schists of Bwlch y groes S. of Bala, Merionethshire; Alt yr Anker, Meifod, Montgomeryshire; schists of Tan y Bwlch y groes S. of Bala, Merionethshire; schists of Allt tre Ffynnon; limestone of Pentre cwm dda, S. of Glyn Diffwys, N. Wales; limestone of Llanfyllin, Montgomeryshire; common in the quartzite of Carn Goran, Cornwall.

(Col. University of Cambridge.)

Orthis sagittifera (M'Coy).

Sp. Char. Rotundato-quadrate or oblong, length usually a little greater than the width, depressed; hinge-line as wide as the shell; receiving valve obtusely subcarinate along the middle, most so near the beak, which is projecting, pointed, very slightly incurved, apical angle 140° , profile only slightly curved, lateral margins horizontal or with a slight mesial wave towards the receiving valve; cardinal area of receiving valve concave, triangular, four times wider than high, inclining backwards at 120° ; triangular foramen narrow, open to the apex; entering valve gibbous, deeper than the greatest depth a little behind the middle, profile strongly arched; cardinal area very narrow, about one-third the height of the other, to which it is nearly at right angles, or in the plane of the margin; beak small, depressed, with a deep narrow mesial sulcus extending from it about halfway to the margin; surface of both valves radiated with very close, numerous, obtuse, subequal, irregular, branching striæ, separated by much narrower, deep, coarsely punctured sulci, about nine in two lines at six lines from the beak, straight in the middle, and along the hinge-line, slightly arched divaricatingly and most branched at the sides, no fasciculation; internal cast of receiving valve without mesial septum, two short dental lamellæ diverging from the beak at 80° , forming part of the lateral boundaries of a short, prominent, flattened, triangular pair of muscular impressions, slightly wider than long, scarcely one-third the length of the shell, usually tripartite by a pair of wide longitudinal sulci, rest of surface finely radiated by impressions of the external striæ; cast of entering valve with the triangular boss of the foramen, slit by a very slender rostral tooth, from which a narrow obtusely angular furrow (corresponding with the external one) extends about half the length of the shell; cardinal teeth forming long deep sulci, rather more than one-fourth the length of the shell, and diverging at 60° , resembling the mark of a broad arrow-head, of which the mesial sulcus was the shaft, surface impressed by the external radiating striæ. Width (of small specimen) 8 lines, proportional length of receiving valve $\frac{97}{100}$, of entering valve $\frac{85}{100}$, depth of receiving valve about $\frac{27}{100}$, depth of entering valve varying from $\frac{25}{100}$ to $\frac{30}{100}$. Length often upwards of 1 inch, the length and depth greater in proportion to the width in these old specimens.

This species is perhaps most nearly allied to the *O. turgida* (M'Coy), from which it is distinguished externally by its flatter receiving valve with nearly straight profile, and a cardinal area less than half the height, and a much more obtuse apical angle;

the striæ are thicker and coarser; internally the difference is still greater, the present species having much shorter and wider muscular impressions in the receiving valve, and the characteristic broad arrow-shaped impressions of the rostral portion of the entering valve, produced by the comparatively long diverging dental lamellæ, wholly separated from the mesial furrow. The gibbous entering valve with its deep narrow mesial sulcus near the beak, coarser striæ, and totally different internal characters separate it from the *O. retrorsistria* (M'Coy), with which it also frequently occurs.

Extremely abundant in the decomposing sandy schists of Aber Hirnant E. of Bala, N. Wales.

(Col. University of Cambridge.)

Orthis turgida (M'Coy).

Sp. Char. Longitudinally ovate, globose, margins very obtuse, greatest width slightly in front of the hinge-line, which is slightly less than the width of the shell; receiving valve very gibbous, profile much arched by the large beak, declining nearly to the level of the lateral margins, greatest depth about the middle of the length; in old specimens there is a faint wide shallow depression towards the front margin, which gradually changes into an obscure prominence towards the beak, or in the young; sides tumid; beak long, apical angle 100° , entering valve extremely gibbous, sometimes hemispherical, in some specimens more depressed, but remaining remarkably tumid towards the margins; a deep narrow sulcus extends from the beak almost halfway to the margin, becoming rapidly effaced by widening and flattening towards the front, which is depressed, with a narrow sinus in young specimens (from the mesial sulcus), and very slightly raised with a wide shallow wave (not affecting the surface) in old individuals (from the slight mesial depression of the old receiving valve); both valves covered with numerous fine, sharply defined, obtuse striæ, separated by flattened spaces, equalling them in width, bifurcating two or three times between the beak and margin, where, in old individuals, they are a little finer than in the middle of the shell, eight or ten in two lines at six lines from the beak, about ten to twelve at the front margin at ten lines from the beak; cardinal area in receiving valve very large, flat, nearly half as high as wide, inclining backwards at 130° ; foramen narrow, triangular, entirely open; area of entering valve flat, triangular, about seven times wider than high: internal *cast* of receiving valve with strong dental lamellæ, diverging at 50° , forming the posterior lateral boundaries of a narrow ovate, strongly defined pair of muscular impressions,

reaching half the length of the shell, not divided by any mesial septum, but having one or two strong sulci on each side; margin finely sulcated by the external striæ, faint extensions of which reach a variable distance towards the beak: cast of entering valve very tumid, nearly smooth, deeply slit towards the beak by the very deep narrow sulcus, left by a thick mesial septum, reaching half the length of the shell, and to which the lamellæ of the very short, thick, cardinal teeth seem to converge, forming the mesial septum by their union, the wide triangular boss of the foramen slit by a slender rostral tooth. Length of small specimen 9 lines, proportional length of entering valve $\frac{7.5}{100}$, width $\frac{8.5}{100}$, depth of receiving valve $\frac{3.5}{100}$ to $\frac{4.5}{100}$, depth of entering valve $\frac{2.5}{100}$ to $\frac{3.5}{100}$. (Length occasionally 1 inch.)

From the great variation in the proportional depth of the entering valve in different specimens, I am uncertain which of the valves is the deepest, although I have little doubt the entering one is so. I have seen small specimens confounded with *O. elegantula*, from which the characteristic turgid appearance from the tumidity of the sides, larger mesial striæ, &c. distinguish it; in the adult state the tumid form and deep short furrow in the rostral half of the entering valve distinguish it easily from all I know.

Extremely common in the schists of Craig y beri, Llanarmon fach, Denbighshire; schists of Coed Sion, Llangadoc, S. Wales; very common in the schists of Aber Hirnant E. of Bala, N. Wales; limestone and coarse schists of Golden Grove, Llandeilo; schists half a mile N. of Conway Falls; common in the limestone of Llandeilo, Caermarthenshire; limestone of Mathyrafal fridd, Meifod, Montgomeryshire.

(Col. University of Cambridge.)

Orthisina Scotica (M'Coy).

Sp. Char. Subquadrate, valves evenly convex, much depressed; hinge-line as wide as the shell, apical angle 120° , sides subparallel, front with an obsolete emargination in the middle; entering valve gently convex, with an obscure narrow mesial depression from the beak to the margin; receiving valve with projecting beak, not incurved, profile consequently nearly straight, very obscurely subcarinate along the middle, sides gradually sloping to the margins; cardinal area very narrow, parallel-sided in the entering valve, wide, flat, triangular, and inclining backwards at only 120° in the receiving valve; pseudodeltidium and deltidial pit concave, foramen oval, near the apex; surface radiated with twenty-eight thick, simple,

subequal ridges, separated by deep sulci rather less than the ridges in width (three in two lines at six lines from the beak in the middle). Width 1 inch, proportional length of receiving valve $\frac{8.5}{100}$, length of entering valve $\frac{7.2}{100}$, greatest depth of both valves (about the middle) $\frac{4.5}{100}$.

There are two or three strong imbrications of growth at the margin, but I cannot distinguish any superficial striæ in the specimens at my command. In form it is intermediate between the *O. inflexa* and the *O. plana* (Pand. sp.), but is more depressed, the beak of the receiving valve not at all incurved, the pseudodeltidium concave outwardly, and is easily distinguished by its comparatively few, thick, simple ribs.

Very common in the concretionary limestone of Craig Head near Girvan, Ayrshire; calcareous shales of Colmonel on the Stincher.

(Col. University of Cambridge.)

Leptæna tenuicincta (M'Coy).

Sp. Char. Rotundato-quadrate; hinge-line as long as the shell is wide; cardinal angles forming nearly rectangular small flattened ears, sides subparallel, obtusely rounded, front wide; receiving valve subhemispherical, very gibbous, greatest depth a little behind the middle of the shell; beak large, prominent, obtuse, incurved to the level of the lateral margins; cardinal area nearly in the plane of the lateral margins, very broad, flat, triangular, height rather more than one-fourth the width; triangular foramen narrow, closed by a convex pseudodeltidium; entering valve very concave, with a mesial septum extending nearly to the margins; surface of both valves marked with very regular, minute, equal rounded concentric wrinkles, having a slight retral wave in the middle of the front, about twelve in the space of one line at the middle of the shell. Width about 5 lines, proportional length of receiving valve $\frac{9.0}{100}$, of entering valve $\frac{7.5}{100}$, depth $\frac{6.5}{100}$.

This beautiful species seems almost identical in size, shape and marking with the *Producta tenuicincta* (M'Coy) and *Leptæna enigma* (Vern.), but has a very wide distinctly marked cardinal area. Lest those species should prove to have areæ when more numerous and perfect specimens can be examined, I give my old specific name to this undoubted *Leptæna*.

Olive schists of Cefn Grugos W. of Llanfyllin, Montgomeryshire.

(Col. University of Cambridge.)

Strophomena spiriferoides (M'Coy).

Sp. Char. Subrhomboidal, sides rather depressed, only slightly convex; hinge-line as wide as the shell; cardinal angles square or slightly acute, sides subparallel, slightly rounded, front very abruptly raised into a quadrate sinus, one-third wider than high, from which a very prominent rotundato-quadrate mesial ridge extends sharply defined to the beak, and an almost equally deep and strongly defined flattened mesial hollow extends to the beak of the receiving valve, both valves radiated with subequal thread-like ridges, occasionally dichotomising (about fourteen in three lines at six lines from the beak): casts of the receiving valve show the closed, cicatrized foramen, with a long slender cylindrical extension of matrix, half a line thick, arching from the apex of the beak into the back, at one-fourth the length from the beak, and two thick, short, slightly diverging cardinal teeth and lamellæ; casts of entering valve show two very short, thick, diverging pits of cardinal teeth, and a large double ovate pit left by the great bifid rostral tooth, and a trace of a slender mesial septum. Average width 1 inch, proportional length of receiving valve $\frac{8.5}{100}$, of entering valve $\frac{6.9}{100}$, depth $\frac{6.0}{100}$.

This is so extremely like the *Spirifera radiata* of the Wenlock limestone, that I have no doubt it has very often been confounded with it, and probably all the examples quoted by authors of *S. radiata* from the Caradoc and inferior strata will be found referable rather to the present shell, which abounds in these inferior rocks, where I have never seen the true *S. radiata* (nor does the present species occur to my knowledge in the Upper Silurian strata). Externally the present shell may be distinguished from the *S. radiata* by its longer hinge-line, flatter sides, and coarser striation, while the internal casts show the generic difference by demonstrating the pit for the great rostral tooth in the beak of the entering valve, and the slender tubular filling of the apical foramen as in the *Leptæna* (*Strophomena*) *sulcata* (Vern.), Bull. de la Soc. Géol. de France, 2nd S. vol. v. p. 31. f. 4, to which it is most nearly allied, but from which it differs by its greater gibbosity, and very prominent mesial ridge and hollow extending from the beak, giving it exactly the appearance of *Spirifera*. The *Orthis Vespertilio* when very finely sulcated might be mistaken for this species, but has the mesial depression in the entering and mesial elevation in the receiving valve, in which also the triangular foramen is open throughout.

Extremely common in the impure limestone of Moel y Garth, Welchpool, Montgomeryshire; very abundant in the limestone

and schists of Bala, Merionethshire; very common in the Caradoc sandstone of Horderly; very abundant in the schists of Alt yr Anker, Meifod, Montgomeryshire; schists of Tan y bwch y groes S. of Bala, Merionethshire; schists of Bryn Melyn near Bala, Merionethshire; schists of Gelli Grin, Bala, Merionethshire; schists S.W. of Pwllheli, Caernarvonshire; schists of Pen y gaer, Cerrig y Druidion, N. Wales; schists of Beavers Grove, Bettws-y-coed, N. Wales; schists of Rhiwargor, &c.

(Col. University of Cambridge.)

Strophomena simulans (M'Coy).

Sp. Char. Truncato-elliptical; hinge-line slightly exceeding the width of the shell, forming short, rounded, semicylindrical ears, from a more or less pronounced indentation of the lateral margins; front wide, elliptically rounded; entering valve gently and slightly convex for about nine lines from the beak, and then more rapidly arched towards the receiving valve to a position sometimes nearly at right angles with the rostral portion; receiving valve nearly as concave as the entering valve is convex externally, except near the beak which is convex; cardinal area rather low, triangular, and nearly at right angles to the plane of the lateral margins; foramen broad, triangular, closed by the pseudodeltidium, except at the apex, where there is a tubular perforation (leaving a little columnar stem-like portion of matrix projecting from the apex of the cast); cardinal teeth very small, bifid, diverging at 115° , the dental lamellæ, originating from them, converge under the muscular impressions, so that their inner gently incurved edges, touching the shell, diverge at about 65° ; muscular impressions undulato-orbicular, about a fifth wider than long, reaching rather less than half the length of the shell; surface sometimes with a few oblique concentric plicæ on the ears; surface regularly radiated with very fine slightly irregular striæ, about twenty-five to thirty in two lines at six lines from the beak, and at that distance usually every 5th, 7th or 9th of the striæ larger than the others, but near the beak they often seem simply alternate in size, the intervening delicate sulci closely punctured. Width 1 inch 10 lines, proportional length of rostral portion about $\frac{30}{100}$, more deflected front about $\frac{30}{100}$, depth at middle of length $\frac{20}{100}$.

This species in size, form, striation and tubular perforation of the apex of the beak almost exactly resembles the *Leptæna alternata*, Conrad, but differs in having the receiving or foraminated valve concave instead of being the convex one; the striation is also finer and flatter or more uniform, which, with the greater

deflection or arching of the valves, also separate it from the *S. grandis*.

The specimens from Blain y cwm and Golden Grove are netted by a beautiful little species of *Vioa* branching frequently, nearly at right angles, forming straight, forking or angularly bending channels, one-fourth of a millimetre in diameter, the branches being at a little more or less than a line apart, and either in the plane of the valves or at right angles to it (leaving round perforations) : it might be called *Vioa rectangularis*.

Not uncommon in the schists of Cefn Coch, Glyn Ceiriog, Denbighshire ; in the olive schists of Golden Grove, Llandeilo, Caermarthenshire ; schists of Blain y Cwm W. of Nantyre, Glyn Ceiriog, Denbighshire ; and one doubtful specimen in the sandy schists of the Malverns, Worcestershire.

(Col. University of Cambridge.)

Leptæna (Leptagonia) ungula (M'Coy).

Sp. Char. Semioval ; hinge-line as wide as the shell, forming short, rounded, slightly projecting ears ; cardinal area low, triangular, with a large tubular foramen at the apex of the beak ; receiving valve horse-hoof-shaped from the slope of the deflected front, being at a much more obtuse angle in the middle of the front than at the sides ; visceral disk depressed, very slightly convex towards the beak, rendered rugged by seven or eight concentric wrinkles (only three or four at the margin commonly seen), angle between the disk and the deflected front obtusely rounded, the depth of the latter being rather less than the length of the disk ; entering valve flat, concentrically wrinkled like the receiving one, but with a narrow margin, equally deflected all round, and only one-fifth or one-sixth the length of the disk ; surface of both valves radiated with extremely fine close obtuse punctate striæ, about twenty-eight or thirty-two in two lines at four lines from the beak, every 3rd, 5th or 7th of which are usually considerably stronger than the others in all the middle portion ; interior of both valves closely punctured and striate ; the close, straight, pallial impressions resemble the external striæ on the deflected front, but are only eighteen in the space of two lines ; interior of receiving valve with two rather long, very slightly incurved dental lamellæ diverging at 105° , including the rotundato-trigonal pair of muscular impressions which are one-third wider than long, and extend about half the length of the disk, being only separated by a slight indication of mesial septum at their anterior edge ; apex of the triangular boss of the foramen with a small abrupt mucro from the entrance of the matrix into the small tubular

opening at the apex of the beak; interior of entering valve with two very short diverging cardinal teeth, and a minute rostral tooth. Width 11 lines, proportional length $\frac{7.5}{100}$, length of disk in receiving valve $\frac{4.7}{100}$, length of disk in entering valve $\frac{6.5}{100}$, depth $\frac{2.5}{100}$.

This so exactly resembles some of the small varieties of *L. deltoidea* and the *L. camerata* (Conrad) as figured by Hall, that I should not have thought of separating them, were it not for the very much finer striæ, which very easily separate the species from our British specimens of *L. deltoidea*. The foramen of the apex of the beak is also larger, the dental lamellæ more divergent, and the muscular impressions much wider. I find the peculiar hoof-like form and other characters of this little shell (unlike *L. deltoidea*) to be extremely constant.

Gregarious, in extraordinary abundance, completely filling some beds of the limestone of Llansaintffraid, Glyn Ceiriog S. of Llangollen, Denbighshire; limestone of Selattyn Road S. of Llangollen, N. Wales.

(Col. University of Cambridge.)

Lingula Davisii (M'Coy).

Sp. Char. Ovato-pentagonal, or broadly subtrigonal, depressed, slightly and broadly convex near the beak, and about half-way to the margins, which become gradually flattened; greatest width at about the middle of the length; front slightly narrowed but very wide, subtruncate, and very slightly convex, obtusely rounded at the lateral angles to the subparallel slightly convex sides; posterior lateral margins rather long, forming an obtuse angle at the sides (usually nearly equalling half the length of the shell, nearly straight, and meeting at the beak at an angle of about 100° in the short and 95° in the long valve); surface with numerous, faint, concentric, rather wide subangular undulations of growth, accompanied by irregular concentric imbricating laminar striæ, ten in one line on the exterior of the shell; no trace of longitudinal external striæ, but on the internal cast a few faint obsolete flattened fibrous radiations observable with the lens. Length 7 lines, proportional width $\frac{7.7}{100}$, depth about $\frac{1.5}{100}$.

This curiously wide satchel-shaped *Lingula* is the species discovered by Mr. Davis in such profusion in the *Lingula* slates near Tremadoc in company with the large elongate *L. ovata* (M'Coy), and I have great pleasure in dedicating the species to him; at the same time I must remark, that except for a slightly greater width and perhaps less coarsely undulated surface, it seems scarcely to differ from the *L. lata* of Pander; as however

this writer gives no description of his species, as his figure gives at least the differences noticed, and as Mr. Sowerby has unfortunately described a totally different Silurian species under the same name, I think (although this latter should not retain the name of *L. lata*) that it is better to give a distinct name to our very abundant and distinctly marked species. The British species most allied to this is the *L. attenuata* (Sow.), which however is easily distinguished by its much longer trigonal, retrally narrowed form, arising from the gradual passage of the sides into the posterior lateral margins (without angulation), the very prominent narrow gibbosity from the beaks, &c. The substance of the shell is very thin, and the traces I have seen apparently of the mesial ridge extend little more than one-third the length of the shell.

Extremely abundant in the greenish slates of Penmorfa, Tremadoc, N. Wales; rare in the schists E. of Nant y Groes S. of Bala, N. Wales.

(Col. University of Cambridge.)

Lingula tenuigranulata (McCoy).

Sp. Char. Shell black, semielliptical; sides parallel, abruptly rounded to the wide, nearly straight front, gradually rounding into the undefined arched posterior lateral margins, which unite elliptically in front of the beak, the curve being rather wider than a semicircle, in the small valve, but more elongate from the projection of the considerably longer beak in the opposite one; valves with a moderate, flattened, triangular gibbosity, widening from the beak to the front margin, from which the sides slope rather abruptly to the margins, the greatest depth being at about the middle of the length; surface with irregular, flattened, concentric laminar wrinkles, strongest on the sides, nearly obsolete in the middle; entire surface covered with extremely minute, close, regular, equal, sharply granular, longitudinal, slightly undulated striæ (about twenty-six in one line in the middle of the shell), the intervening spaces between the striæ about equalling the striæ in width. Length (of shorter valve) 1 inch 9 lines, proportional width $\frac{70}{100}$, depth $\frac{25}{100}$.

This species far exceeds the *Lingula quadrata* (Eichwald) in size, though that has hitherto been the largest species known; it is easily distinguished therefrom as well as from the *L. granulata* (Phill.), to both of which it bears some resemblance, by the extremely minute granular lineation of the surface (which is quite invisible to the naked eye, or with a lens of low power only giving a dullness to the surface) and the semielliptical regular arch formed by the union of the two posterior lateral margins of the

shorter valve. In the *L. quadrata* also the front is much rounded and narrower, and the rather strong mesial lineation of the decorticated specimens does not occur in our species, in which, when the surface is removed, there are only seen traces of obsolete, broad, longitudinal fibrous bands, not at all confined to the middle of the shell, nor linear in character. As usual in fossil *Lingulæ*, it is the beak only of the smaller valve which is seen most commonly; but two of our specimens show the pointed beak of the larger valve, extending a quarter of an inch beyond the rostral margin of the other, the two being undisturbed from their original position.

Common in the sandy and calcareous schists of Alt yr Anker, Meifod, Montgomeryshire; sandy schists of Das Eithin ridge, Hirnant, Montgomeryshire.

(Col. University of Cambridge.)

Spondylobolus (M'Coy), n. g.

Gen. Char. Suborbicular, slightly narrowed towards the indistinct, short hinge-line, nearly equivalve, flattened; small valve with a slightly excentric apex, beneath which, on the interior, the substance of the valve is thickened into a wide undefined boss; opposite valve slightly longer, from the apex being perfectly marginal and slightly produced, channelled by a narrow triangular groove, the anterior end of which is flanked within by two very prominent thick conical shelly bosses, representing hinge-teeth: substance of the valves thick, testaceous, not glossy, minutely fibrous, but not distinctly punctured under a lens of moderate power, except by the ends of the fibres.

One species of this genus is indistinctly known already from the figures and descriptions of Mr. Davidson under the name *Crania Sedgwickii*, the prominent cardinal protuberance being taken for the posterior pair of muscular impressions; neither the tissue of the shell nor the internal impressions, however, are identical with those of *Crania*. The grooving of the beak* of one valve, and the depressed orbicular form, show the strongest affinity to the Russian genus *Obolus*, which differs however by its glossy corneous substance, peculiar internal impressions (as figured by Kutorga), and want of the conical cardinal bosses. These latter, as well as the terminal beak of one valve and sub-central beak of the other, remind us of *Trematis* of Sharpe; but neither of the specimens I have examined of the small valve show the fissure of that genus, nor does Mr. Davidson allude to any-

* Although this is not seen in the published figure of the *C. Sedgwickii*, I detected it in the original specimen, which, however, has been obscured by too much clearing with the knife.

thing of the sort in his large species; and further, the coarse punctation of *Trematis* does not exist here. I think its zoological position very doubtful; the greatest affinity is probably with *Siphonotreta* (which it resembles very much if the tube in the beak be viewed as modified into a groove by a cleft or division of the internal rostral pad, the walls of which would thus correspond to the cardinal bosses of the present genus, forming a passage thus to *Obolus*). I think a peculiar family should be formed to include those three genera, the family being placed between *Crania* and *Discina*.

Spondylobolus craniolaris (M'Coy).

Sp. Char. Suborbicular, depressed, slightly undulated, the width scarcely exceeding the length, front and sides broadly rounded, slightly acuminate behind; apex near the posterior margin; substance of the shell thick, calcareous, smooth, with very minute faint concentric striæ, very minutely fibrous, but the punctation (if it exists) indistinct; beak of small valve small, obtusely pointed at about one-fourth the length from the posterior margin; beneath the beak the shell is greatly thickened, forming an obtuse wide pad, internally reaching nearly to the margins; beak of larger valve terminal, slightly produced, apparently channelled below by a triangular groove, on each side of the base of which is a strong conical boss, projecting into the cavity of the opposite valve like cardinal teeth; surface dull, nearly smooth, or showing under very strong glasses an indistinct, very minute punctation (perhaps due to the fibrous tissue of the shell) and delicate concentric striæ. Length 4 lines, width $4\frac{1}{2}$ lines.

The specimens I have examined are chiefly internal impressions, showing two very deep small oval pits near the hinge-line, resembling the so-called *Crania Sedgwickii* of Davidson (Bull. de la Soc. Géol. de France for October 1848), from which it differs in the greater approximation of these impressions (which are clearly not analogous to the muscular impressions of *Crania*), smaller size, &c.

Five or six specimens have occurred in the shale of Bultth Bridge, Radnorshire.

(Col. University of Cambridge.)

Holopella tenuicincta (M'Coy).

Sp. Char. Very elongate, spiral angle 20° , whorls probably eight or nine, but only five or six usually preserved, gently convex, sutures simple, deep, sutural angle 80° ; surface girt with close,

fine, sharp, subequal, spiral striæ (about thirty-five in the space of one line on the basal whorls), crossed by a few obsolete, sigmoidally arched lines of growth. Length about 8 lines, width at base 3 lines, length of last whorl 2 lines, length of penultimate whorl $1\frac{1}{2}$ line.

I imagine this may be the Scotch fossil referred by Mr. Salter (Quart. Geol. Journ. for August 1851) to the Upper Ludlow, *Turritella* (*Holopella*) *obsoleta* of Sowerby, as it has very much the same size and shape; and the distinctive spiral lineation requires a good cross light and some care to detect*; but with these and a lens of low power it may be always seen, even in the sandstone casts, and the species thus easily distinguished from that of the newer rocks. The sutures are always more oblique than in the *H. obsoleta*. The slight inequality of size of the striæ seems in parts subalternate, in parts irregular.

Common in the sandstone of Mulock quarry, Dalquorhan.
(Col. University of Cambridge.)

* I have since demonstrated the striation to Mr. Salter in his specimen.

CHAPTER XII.*

DEVONIAN FOSSILS.

Stegano dictyum (M'Coy), n. g.

Etym. Στεγανός, *covered*, and δίκτυον, *a network*.

Gen. Char. Polymorphous, forming either narrow, rounded, branch-like masses, or extended into thin, flat, foliaceous expansions; the interior of all the forms composed of rather large, irregular, polygonal or subhexagonal cells, the three dimensions of which are approximately equal (commonly about half a line in diameter), which become rapidly smaller towards the exterior, blending with the dense covering of the surface, which is variously sculptured with close waving lines, tubercles or costæ according to the species; surface dense, foraminated by the contracted, rather distant openings of the small cell-mouths.

These curious zoophytes abound in a particular layer of dark Devonian schist near Polperro on the coast of Cornwall, and are the bodies which have been taken for fossil fishes by all previous observers—the thick reticulated fragments being quoted as “bones of *Asterolepis* ;” flat sculptured portions being taken for the scaly parts of various fishes, and the midribs of some of the fronds being supposed to be “*Ichthyodorulites*, as *Diplacanthus*, *Ctenacanthus*, and Upper Silurian species of *Onchus*.” The supposed correctness of the latter identifications induced Sir R. Murchison to colour the part of the Cornish coast where these fossils occur as Upper Silurian, in his last map of that region. I first examined a good suite of these supposed Cornish fossil fishes at the Museum of Economic Geology, Jermyn Street, in company with Prof. Sedgwick last July, and at once demonstrated their true nature to Mr. Salter, who was kind enough to allow me to examine them closely. I subsequently examined the originally figured and described specimens at the Museums of Penzance and Truro, and finally visited the localities where they are found, and procured numerous specimens, now in the Geological Museum at Cambridge, as well as examined

* The species in this chapter date from the ‘Annals’ for Dec. 1851.

a great quantity not worth removing. The most remarkable character of these sponges is the thin, very dense, superficial covering to the coarse cellular internal network ; which however might be almost paralleled by a slice of the common large cup-sponge of Ceylon. As so many authorities for whose opinions I entertain a high respect supposed the reticulation to be the cancellated structure of bone, I thought it due to them, that transparent microscopic sections should be prepared of some of the most bone-like portions and submitted to powerful microscopes, and for this purpose I trespassed on the kindness of my friend J. Carter, Esq., of Petty Cury, Cambridge, who possesses not only an extremely fine microscope, but admirable skill in the use of it and in the preparation of the objects. I have to thank him for not only putting slices of the present fossils under a high power, but making similar slices, for comparison, of fossil bones of various animals and of sponges—the results entirely confirming the opinion I had formed from an examination with my naked eye, namely, that there was no bone-structure whatever in the Cornish fossils ; which indeed was obvious enough to any one reflecting on the way in which bones grow.

Steganodictyum Cornubicum (M'Coy).

Sp. Char. Fronds forming large, flat, slightly undulating expansions, about one line thick, and several inches long and wide, with irregular broad, transverse undulations or impressions ; the middle supported by a thick, simple, gradually tapering, stem-like portion, which has a thickness and width of about three lines at 4 inches from the apex ; surface of stem and frond, or lateral expansions, generally dark-coloured, dense, and uniformly marked with close, equal, broad, flat, longitudinal ridges, separated by deep sulci only one-fourth or one-third the width of the ridges (about eleven ridges in the space of two lines on all parts of the surface) ; the direction of the ridges is irregular, being sometimes over large spaces perfectly straight and parallel, but more usually much undulated ; under a strong lens the ridges are seen to be punctured by numerous minute cell-openings, from one to three irregular rows to each ridge, rather more than their diameter apart ; cell-structure of the interior, coarse, polygonal, averaging six cells in the space of two lines.

The midrib of this species is often found separated from the thin, foliaceous expansions, and has been then described as Ichthyodorulites of the genera *Onchus*, *Ctenacanthus* and *Diplacanthus*. I have however repeatedly noticed its contact with, and

gradual passage on each side into, the flat, similarly striated frond.

Extremely abundant in a bed of blackish Devonian shale in Lantic and Lantivit Bays on the south coast of Cornwall near Polperro, and striking into Fowey Harbour, accompanied by occasional specimens of the *Bellerophon bisulcatus*, Röm. (the Devonian shell confounded with the Silurian *B. trilobatus* by those English geologists who have quoted the latter species from the British Devonian strata).

(Col. University of Cambridge.)

Steganodictyum Carteri (M'Coy).

Sp. Char. Flattened expansions, often less than one line thick; internal cellular structure rather finer than that of the *S. Cornubicum*: surface covered with subequal, elongate oval prominent tubercles, averaging twice as long as wide (half a line long), arranged sometimes in quincunx, sometimes in irregular lines, the rows from half a line to one line apart, but usually three to four tubercles in a space of two lines; flat spaces between the tubercles marked with a parallel striation, usually oblique to the tubercles, crossing those which are but slightly elevated, but obsolete on the more prominent ones (about nine sulci in a space of one line); both tubercles and oblique sulci punctured by the openings of the minute cell-mouths, which are about their diameter apart, and averaging eight to nine in a space of one line.

This species is very much rarer than the *S. Cornubicum*, from which it is easily distinguished by its tuberculated surface. I have great pleasure in dedicating it to my friend Mr. Carter.

Rare in the dark Devonian schists of Lantivit Bay, Cornwall.
(Col. University of Cambridge.)

Uncites laevis (M'Coy).

Sp. Char. Longitudinally ovate, oblique; entering valve when young ovate, with the front and lateral margins broadly rounded, when old becoming very gibbous and subrhomboidal from the convergence of the sides to a narrow rounded front; receiving valve obtusely subcarinate along the middle when old by the nearly flat sloping of the sides, the front margin not perceptibly elevated, and the lateral margins nearly horizontal; beak very large, sharply pointed, and widely arched inwards obliquely to one side, the under part of the beak widely channelled with obtusely angular or rounded lateral margins; surface smooth, or only marked by the concentric

lines or imbrications of growth towards the margin. Length of receiving valve $2\frac{1}{2}$ inches, proportional length of entering valve $\frac{7.5}{100}$, width $\frac{6.0}{100}$, depth of both valves $\frac{5.5}{100}$. Thickness of shell in beak of receiving valve 2 lines, above the beak of entering valve on one side 5 lines, on the other side 4 lines, diminishing the cavity to 2 lines in diameter; thickness of shell about the middle of the sides of receiving and entering valve 3 lines, diminishing to little more than 1 line along the middle, and gradually thinning to the margins; length of young specimens 9 lines, proportional length of entering valve $\frac{8.0}{100}$, width $\frac{8.0}{100}$, depth of both valves $\frac{4.5}{100}$.

The general narrow elongate form, and the oblique torsion of the long, narrow, claw-like beak in this species, exactly reminds us of the *Uncites gryphus* of DeFrance, from which it is distinguished by the absence of the longitudinal sulcation. Having first ascertained the true internal characters of that curious Eifel fossil, it gave me great pleasure to recognise in our British rocks a second species of this remarkable genus. I should have imagined that the *smaller* of the two figures given in Sowerby's 'Mineral Conchology' under the name of *Terebratula porrecta* represented a young individual of this species, on account of the narrow produced front, but as Mr. Sowerby himself has since stated (G. T. 2 S. vol. v. expl. of t. 56) that those figures represented the *Stringocephalus Burtini*, and as all writers seem to coincide in that opinion, I have only to observe, that the present fossil, by the complete absence of internal septa, and the external characters above enumerated, has no affinity whatever therewith.

Not uncommon in the Devonian limestone of Newton Bushel, Devonshire.

(Col. University of Cambridge.)

Orthis persarmentosa (M'Coy).

Sp. Char. Transversely oblong, hinge-line nearly the length of the shell, ends obtusely subtruncate, slightly rounded; surface covered with thick, rugged, rounded, flexuous, radiating ridges, about half their thickness apart (about five in three lines in the middle of the shell at six lines from the beak), branching four or five times between the beak and margin, counting about 130 at the margin of a large specimen, those towards the sides straighter and finer than those in the middle. Average width 3 inches; length probably one-third of the width, but cannot be stated accurately, owing to the distortion of all the specimens.

This species very closely resembles the *O. sarmentosa* (M'Coy)

of the older rocks in form, and the peculiar twig-like mode of branching of the ribs on the middle of the shell, and the straighter and finer ones of the sides, but is distinguished by the very much greater number of the ridges. As in the case of that species the distortion is usually such, that I can make no probable approximation to the proportional length. The coarseness of the ridging separates the present species from the American *Strophomena nervosa* and *S. bifurcata* (Hall) of the Chemung group.

Common in the Devonian shale of Polruan, Cornwall; in the reddish Devonian schists of E. Looe; schists of Fowey.

(Col. University of Cambridge.)

Strophomena gigas (M'Coy).

Sp. Char. Rotundato-trigonal; hinge-line equal to the width of the shell; sides gently convex, converging to a narrow, much-rounded front; valves much flattened, slightly convex; surface radiated with very numerous fine, close, obtuse striæ, separated by narrower finely punctured impressed lines, every fifth, seventh, or ninth of which seem larger than the rest (about sixteen striæ in two lines at an inch from the beak, fifteen in the same space at the margin 3 inches from the beak); cardinal area broad: internal casts of receiving valve in adult specimens show the pair of muscular impressions, forming a slightly bilobed or subtrigonal mass, about one-third wider than long, and reaching rather more than one-third the length of the shell, each side marked with six or seven very coarse radiating ridges; mesial septum very small. Average length 3 inches 2 lines, proportional width $\frac{9.5}{100}$ to $\frac{100}{100}$, width of cardinal area nearly 2 lines.

This gigantic species in its elongate-elliptical or subtrigonal form, arising from the narrow rounded front, precisely agrees with *Orthis subarachnoidea* of MM. D'Archiac and De Verneuil (Geol. Trans. 2 S. vol. vi. t. 36. f. 3), but differs from it in the larger striæ at subregular intervals between the group of smaller, as well as its great size. I have seen and made drawings of a large number of specimens in the private collections of persons at or near Looe, although there is only one indifferent specimen in the University collection; I am therefore better prepared to decide on the characters of the species than I should otherwise have been.

Common in the Devonian shale of Looe, and of Polruan, Cornwall.

(Col. University of Cambridge.)

Strophomena nobilis (M'Coy).

Sp. Char. Semicylindrical ; entering (?) valve very gibbous near the beaks, strongly arched downwards into a subcylindrical deflected front, the sides of which are slightly flattened to join the obscurely defined ears, which project from the gibbous beak, and are nearly rectangular ; front rounded : surface radiated with narrow distinctly defined ridges, of about equal thickness throughout ; about twenty originating from the beak, between each pair of which, after about the length of 1 inch, a new ridge equal to the primaries in size is developed, so that nearly over the whole shell the subequal ridges are little more or less than a line apart ; the intervening spaces slightly concave, three times wider than the ridges, crossed by very deep, strong, irregularly curved concentric wrinkles, not crossing the ridges, scarcely four in a longitudinal space of three lines ; entire surface, ridges and furrows marked with very fine slightly irregular longitudinal distant striæ, nine in the space of 1 line, strongly punctured when the outer layer of shell is removed. Width at hinge-line 2 inches 4 lines, proportional length about the same, depth (greatest at one-third from the beak) $\frac{6.5}{100}$.

This fine species is so completely unlike any other, that it is unnecessary to point out the distinctions ; the nearest analogue apparently being the comparatively little, flat, few-ribbed *Orthis undulata* (M'Coy, Synopsis of the Silurian Fossils of Ireland, t. 3. f. 22. of the Silurian Series), with which however it has no specific affinity.

Devonian limestone of Torquay.

(Col. University of Cambridge.)

Leptodomus constrictus (M'Coy).

Sp. Char. Oblong, or subtrigonal from the projection of the very prominent beaks ; valves very tumid towards the anterior side, greatest depth at about one-third from the beak ; anterior end subtruncate, projecting but slightly towards the ventral portion beyond the line of the beaks ; anterior lunette very large, ovate, deep, smooth ; a deep narrow sulcus extends from the beak, slightly widening to the nearly straight ventral margin, which it meets at about 50°, forming a small sinus ; posterior side much compressed, posterior slope not defined, posterior end obtusely subtruncate with a slight obliquity ; hinge-line straight, rather shorter than the posterior side ; anterior side and middle of the valves deeply marked with coarse concentric wrinkles, arising from the edge of the smooth anterior lunette, and most of them becoming abruptly obsolete on the posterior

half of the shell ; those near the margin of old specimens about one line wide, gradually diminishing towards the beak. Length 1 inch 2 lines, proportional width from beak to opposite ventral margin $\frac{7.7}{100}$, length of anterior lunette $\frac{3.7}{100}$, width of posterior end about $\frac{6.5}{100}$, depth of one valve about $\frac{4.0}{100}$.

This species in size, shape, subtruncate anterior end, and coarse concentric wrinkles of the anterior half becoming obsolete on the posterior portion, almost exactly resembles the *L. truncatus* (M'Coy) of the Upper Ludlow rock, but may be distinguished easily by the strong divisional sulcus from the beak. I suspect the fossil from Baggy Point, referred by Phillips (Pal. Foss.) to the Silurian so-called *Cypricardia impressa* of Sowerby, may be found to belong rather to the present species.

One young specimen, 5 lines long, of the left valve, and two large specimens in opposition of the right valve, have occurred in the sandstone of Marwood, N. Devon.

(Col. University of Cambridge.)

Clymenia quadrifera (M'Coy).

Sp. Char. Discoid, compressed, nearly two-thirds of the whorls concealed ; whorls about four and a half, crossed by very minute sigmoid striæ ; periphery* narrow, obtusely rounded ; septa with the middle portion crossing the periphery small ; *first sinus* small, oblique, very obtusely rounded ; first lobe nearly in the middle of the side, nearly square, slightly rhomboidal, length and width about equal, truncated at the broad extremity, the angle next the umbilicus rather more obtuse, and the other slightly more acute than a right angle, sides subparallel ; second sinus slightly higher than the first, extending with scarcely any curvature to the umbilicus, its width double that of the lateral lobe, which is placed nearly in the middle of the side ; dia-

* In descriptions of discoid Cephalopod shells, as Ammonites, &c., conchologists almost invariably use the terms "*back* or *dorsal*, and *ventral*," exactly in the opposite sense to what anatomy or the position of the animal would indicate. I therefore propose to use the term "*periphery*" for that part commonly called by describers of these shells the "*back*," or by anatomists the "*ventral aspect*," as the use, at this late period, of the latter term would bring much unnecessary confusion into the descriptions ; for the opposite edge of the mouth I use the term "*inner edge*." In describing the septa of the same shells and for the same reason, instead of "*dorsal lobe*" I use the term "*mid-lobe*," or "*inner mid-lobe*," for the so-called "*ventral lobe*" of Von Buch and all other describers. Instead of "*first lateral superior*, *first lateral inferior*, and *first*, *second*, &c. auxiliary lobes," terms which are unnecessarily complex, I propose to number and describe the lobes simply as *first lobe*, *second lobe*, *third lobe*, &c., reckoning from the outer *mid-lobe*, or, as it has usually been called, the *dorsal lobe*. The word *sinus*, I think, may be used instead of *saddle* for the inflexion between each pair of lobes.

meter 1 inch 3 lines, proportional diameter of last whorl $\frac{54}{100}$, width of mouth at edge of umbilicus $\frac{31}{100}$, width of periphery about $\frac{17}{100}$.

This species is easily distinguished from all others by the remarkably defined, nearly square form of the lateral lobe. It is most allied to the *Chymenia striata*, Münster, from which it is easily distinguished by the very obtusely rounded, obscurely defined first sinus, and the regular, almost square-formed lobe and the scarcely curved margin of the second sinus; the cast of that species is also marked by sigmoid ridges, of which there is not the slightest trace on the present fossils. I have seen traces both of the *evanescent* thread-like middle and lateral keels occasionally noticed on the other species.

Very rare in the Upper Devonian limestone of S. Petherwin. (Col. University of Cambridge.)

Clymenia Pattisoni (M'Coy).

Sp. Char. Discoid, compressed, of about five whorls, rather more than one-third of each being concealed by the preceding turn; section of the whorls semielliptical, greatest thickness near the edge of the umbilicus, which is considerably wider than the whorl; sides very slightly convex, gradually converging to the obtusely rounded periphery, to which there is often super-added a very fine thread-like mesial keel and two lateral ones; surface finely striated transversely; siphon large, close to the inner margin; septa about one-third the width of the side apart, with the middle portion nearly transverse, no lateral lobe, but the edges after about the middle of the side arching backwards and then forwards again to the edge of the umbilicus, forming an obtusely rounded first sinus, which extends backwards about half the space between the septa farther than the middle portion. Diameter 9 lines, proportional diameter of umbilicus $\frac{48}{100}$, of last whorl $\frac{40}{100}$, width of mouth $\frac{25}{100}$.

This species belongs to that very restricted first group of *Clymenia* according to Münster, in which the edges of the septa are only slightly arched; it is most nearly allied to the *C. compressa*, Münster, from which however, on comparing with authentic specimens, I find it differs by the great size of the umbilicus, which in that species is much less than the last whorl, forming scarcely $\frac{30}{100}$ of the entire diameter. The septa differ from all of this group in the greater forward curvature of the umbilical end of the edge of the septa, thus forming a distinct rounded sinus, from which the edge passes with very little curvature across the outer half of the sides and periphery, forming no

lateral lobe or medial saddle (*sinus*) as in the other allied forms; this flection forward to the umbilicus distinguishes this part very strongly from *C. lævigata*, which also has very much more numerous whorls and larger umbilicus. I have much pleasure in dedicating this species to Mr. Pattison of Launceston, to whose labours in collecting, I believe, are due the discovery of nearly all the British specimens of *Clymenia*.

Rare in the Devonian limestone of S. Petherwin.

(Col. University of Cambridge.)

Cyrtoceras subornatum (M'Coy).

Sp. Char. Gradually arched, involute; section of the whorls a regular transverse ellipse, the shortest axis in the plane of involution; tapering at the rate of 5 lines in 2 inches from a diameter of 1 inch 5 lines; periphery broadly arched, inner face rather more convex; sides elliptically rounded, with an obscure spiral ridge on each side along the most prominent part, bearing a row of large obtuse conical tubercles, nearly twice their diameter apart; on each side of this principal row of tubercles is a secondary obscure row, about half as far from the principal ridge as the tubercles of it are from each other, the outer of these rows most distinct, the inner nearly obsolete; these three sets of tubercles are connected by very obscure transverse wrinkles, which do not extend beyond them across the inner aspect, or the periphery; entire surface crossed by very minute, imbricating waving lines of growth having a very obtusely angular backward sinus in the middle of the periphery, all crossed by very faint longitudinal folds half a line apart, never assuming the prominence of striæ or ridges; siphon close to the outer margin. Proportional length of mouth as compared to the width $\frac{80}{100}$.

This beautiful species is most nearly allied in form, size, septa, siphon and striation to the *C. ornatum* (Goldf.), as figured by D'Archiac and De Verneuil in the 'Geol. Trans.' vol. vi. t. 28. f. 5, but is rather less rapidly curved, and is completely distinguished by the two or three rows of tubercles being very small, and entirely confined to the sides, leaving the broad periphery completely free of them.

One fragment in the Devonian limestone of Plymouth.

(Col. University of Cambridge.)

CHAPTER XIII.*

PALÆOZOIC MOLLUSCA.

Sanguinolites decipiens (M'Coy).

Desc. Elongate-oblong, dorsal and ventral margins subparallel; beak incurved, small, depressed, about one-fifth the length from the anterior end; hinge-line long, not elevated (the inflected edges forming a nearly horizontal posterior lunette extending its entire length); cardinal angle about 115° ; anterior end rounded, narrowed by an elongate, elliptic lunette; a strong sigmoidally contorted diagonal ridge extends from the beak to the respiratory angle; posterior slope steeply inclined; posterior end slightly oblique, subtruncate, rounded; ventral margin with a wide, rather deep sinus in the middle, from which a wide concavity extends nearly to the beak, and from the diagonal ridge to the anterior end, which is convex anterior to the beaks; surface marked with sharp concentric wrinkles from the anterior lunette to the diagonal ridge. Length 8 lines; in proportion to the length, greatest width (from beak to opposite margin) $\frac{4.8}{100}$; length of anterior end $\frac{2.0}{100}$, from the beak to end of hinge-line $\frac{6.5}{100}$; greatest depth of one valve (about middle of diagonal ridge) $\frac{2.5}{100}$.

I have seen numerous specimens of this species from the Upper Ludlow rocks, usually confounded with the so-called *Cypricardia cymbiformis* (Sow.), which it strongly resembles at first sight, although the anterior end is considerably longer. That fossil, however, has simple erect dorsal margins, and belongs to the genus *Orthonotus*, while the distinctly inflected dorsal edges forming the elongate, concave, posterior lunette show the present species to belong to the genus *Sanguinolites*.

Not uncommon in the Upper Ludlow rock of Benson Knot, Kendal, Westmoreland; and in the micaceous grits of Llechellawdd Myddfai, near Llandovery, S. Wales; greenish schists of Balmae shore, Kirkeudbright.

(Col. University of Cambridge.)

* The species in this chapter date from the 'Annals' for Sept. 1852.

Capulus ? Euomphaloides (M'Coy).

Desc. Depressed, spirally inrolled, whorls rounded; spire depressed, of one and a half turns; surface apparently smooth, or faintly marked by broadly undulated wrinkles of growth (indicating the waving of the right lip). Diameter 1 inch, proportional diameter of body-whorl $\frac{5.0}{100}$, height $\frac{5.7}{100}$.

This curious species is so much depressed, that were it not for the small size of the spire and the undulation of the lip, as revealed by the flexuous lines of growth, it might be taken for a *Euomphalus*. I at one time thought it might be desirable to form a particular genus for those palæozoic species, such as the *Nerita Haliotis* (Sow.), *Pileopsis neritoides* (Phill.), &c., having the form of *Nerita*, but an undulating lip and lines of growth; on examining carefully the recent *Pileopsis intortus* and allied species, I found so gradual a passage from them to the ordinary cap-shaped forms, that I prefer leaving them altogether for the present. None of my specimens of that type of shells show the mouth clearly, so that it is possible they may want the inner lip, in which case the genus would be a very good one, and only found I believe in the older rocks.

Rare in the Lower Ludlow limestone at Green quarry, Leintwardine, Shropshire.

(Col. University of Cambridge.)

Pleurotomaria crenulata (M'Coy).

Desc. Obtusely trochiform, length and width nearly equal; apical angle 85° ; spire of four obtusely rounded whorls, most convex below the middle; band broad, depressed, bounded by two delicate prominent keels, the upper edge being a little below the middle of the whorl; a space equal to the band in width is visible below it on the turns of the spire; base flattened, gently convex, slightly umbilicate; surface with close, sharp, irregular, interrupted striæ, slightly arched backwards from the spire to the suture, and in the opposite direction beneath it; the oblique striæ faintly crenulated by very minute spiral striæ, the band with coarse, irregular, backward arched lines only. Length 6 lines, proportional width $\frac{8.6}{100}$, length of body-whorl $\frac{5.0}{100}$.

This bears some slight resemblance to the *Turbo carinatus* (Sow.) of the Upper Ludlow, but is generically distinct by its

striae arched backwards to the band; its spire is also shorter, and there are no spiral ridges on the base.

In the Upper Ludlow rock of Brigsteer, Kendal, Westmoreland.

(Col. University of Cambridge.)

Murchisonia cancellatula (M'Coy).

Desc. Conic; apical angle about 50° ; spire of four whorls, obtusely angulated a little below the middle; the part above the keel oblique, slightly convex near the sutures, slightly concave near the keel; portions below the keel convex; body whorl of moderate size; base apparently imperforate (but imperfectly seen); mouth obscurely rhomboidal, a little wider than high. Length 1 inch 2 lines, proportional width $\frac{87}{100}$, height of body-whorl $\frac{45}{100}$; entire surface above and below the keel reticulated by nearly equal spiral and backward curved, oblique, transverse sulci, eight or nine in one line.

Mr. Salter, on a casual examination of some of our specimens of this species, supposed them to belong to his *Murchisonia scalaris* (Geol. Journ. vol. v. t. 1. fig. 2), which he there says is a common Bala species, recognized by its elongate shape, &c., and imperfect specimens of the exterior of which he says show the fine striae curving back to the keel; but as the carinated species I have seen from Bala are quite different from the present, and agree with the above figure in the elongate form, so different from the present shell, which also has strong spiral striae, not said to exist in the *M. scalaris*, nor in the Bala forms which I have seen, I conceive this to be a perfectly distinct species.

In the Upper Bala rock of Allt yr Anker, Meifod, Montgomeryshire; abundant in the sandstone of Mullock quarry, Dalquorhan, near Girvan, Ayrshire.

(Col. University of Cambridge.)

Murchisonia gyrogonia (M'Coy).

Desc. Acutely conical; apical angle 45° ; spire of three and a half whorls, very strongly angulated in the middle by the projection of an acute carina, the upper and under sides of the volution being flat and steeply inclined; sutural angle 70° to 75° ; body-whorl rounded below, with an additional fine keel about halfway between the principal one and the anterior end, which is almost hid by the suture on the spiral whorls; surface (when preserved) marked with sharp striae, which, on the upper part of the whorl, extend from the suture obliquely

backwards to the keel, curving in the opposite direction below the keel. Length $4\frac{1}{2}$ lines, proportional length of last whorl $\frac{5.5}{100}$, width $\frac{7.0}{100}$.

This is most allied to the *Murchisonia perangulata* (Hall) of the Bird's-eye limestone of the New York series, but is distinguished by the shortness of the spire in proportion to the body-whorl, and by the additional keel below the band on the last turn. It is also closely allied to the *M. pulchra* (M'Coy, Sil. Foss. Irel. t. 1. fig. 19), but is on comparison found to be distinct by the fewer, longer, and more produced whorls of the spire.

Very abundant in the fine sandy schists of Yspetty Evan, N. Wales; also in the calcareous strata W. of Llanfechan, Montgomeryshire.

(Col. University of Cambridge.)

Murchisonia simplex (M'Coy).

Desc. Acutely conical; apical angle 55° ; spire of about four or five whorls, angulated in the middle by the projection of an obtuse thick keel, another keel a little smaller between the suture and the keel above, and a third nearer the suture below on each turn; surface marked with fine striæ of growth, arched back to the keel at a moderate angle above, and nearly vertical below; base imperforate. Width of small specimens 6 lines, length of last turn 5 lines (imperfect specimens double this size).

The more elongate form and imperforate base distinguish this species from some of the "Trenton limestone" varieties of the *Pleurotomaria umbilicata* (Hall); and the same characters and the absence of the spiral striæ on the base distinguish it from the *Euomphalus triporcatus* (M'Coy).

I should have supposed the *M. scalaris* (Sow. and Salt.), Geol. Journ. vol. v. t. 1. fig. 2, Ayrshire, belonged to this species, but that one, instead of five, keels are indicated in the figure and text.

Limestone of Allt yr Anker, Meifod, Montgomeryshire; also in the sandstone of Dalquorhan, near Girvan, Ayrshire; greenish trappean sandstone of Glenquhaple, Ayrshire.

(Col. University of Cambridge.)

Murchisonia torquata (M'Coy).

Desc. Acutely conic; apical angle about 26° ; whorls six, having a thickened prominent suture, below which the upper portion

of each is slightly concave, becoming very convex in the lower half; band narrow, below the middle on the most convex part of the volutions; striæ sharp, strongest on the thickened edge of the suture, arching obliquely backwards to the band. Length 6 lines, proportional length of last turn $\frac{40}{100}$, width $\frac{50}{100}$.

As neither the collar-like thickening of the upper edge of the suture, nor the greater projection of the lower part of each whorl, are indicated by Mr. Sowerby in his figure or description (in the Sil. Syst.) of the *P. Corallii*, I suppose the present species to be distinct.

Common in the Upper Ludlow of Spital and Benson Knot, Kendal, Westmoreland; tilestone of Storm Hill, Llandeilo, Caermarthenshire.

(Col. University of Cambridge.)

Euomphalus lyratus (M'Coy).

Desc. Spire only slightly elevated, of two very convex turns, each with three narrow spiral ridges, one at the upper suture, one considerably above the middle of the body-whorl and corresponding to the lower suture on the spire, and the third halfway between these two; surface crossed by slightly oblique, thin, cord-like ridges, nearly twice their thickness apart. Diameter about 6 lines, proportional height about $\frac{50}{100}$.

Only one imperfect specimen has occurred of this obviously distinct species, not allowing of the characters of the base or spire being completely ascertained.

Rare in the Bala schists at Llansaintfraid, Glyn Ceiriog, Denbighshire.

Euomphalus triporcatus (M'Coy).

Desc. Obtusely conic; apical angle about 95° ; spire of about three or four flattened whorls, each bearing three nearly equal and equidistant, thick, obtuse carinæ, one of which is at the suture, which it renders canaliculate, one in the middle, and one forming the circumference of the basal whorl, and partially concealed by the suture in the spiral whorls; base convex, with three smaller spiral carinæ and a minute umbilicus; surface crossed by sharp, scaly, delicate, transverse striæ. Width 1 inch, proportional length about $\frac{75}{100}$, length of last whorl $\frac{42}{100}$.

Col. Portlock has, I think, figured this species (Geol. Rep. t. 30. fig. 3) as the *E. subsulcatus* of Hisinger, which has double

the number of spiral keels on the upper surface. I should have referred those specimens to the *E. cornu-arietis* (His.), but that seems to have four large ridges to each whorl, and no indication is given in the figure or description of the spiral carinæ on the base. It much resembles some of the varieties of the *Pleurotomaria umbilicata* (Hall) from the Bird's-eye limestone of New York, but is certainly distinguished by its smaller umbilicus, and the three additional spiral keels on the base; those latter are generally best seen in the concavity left when the upper whorls of a specimen are broken away (described from internal casts).

Common in the Bala slates of Cyn-y-Brain, Wrexham, Denbighshire; and in the schists of Golden grove, Llandeilo, Caermarthenshire.

(Col. University of Cambridge.)

Machureia macromphala (M'Coy).

Desc. Discoid, sinistral, usually elliptical, of about three and a half rapidly enlarging whorls; spire depressed below the level of the outer turn, which bears an obscure, obtusely rounded angulation, bounding the slightly oblique upper plane of the shell; circumference obtusely rounded; under side having the middle of the whorls obtusely angulated, thus defining a wide, shallow umbilicus. Diameter 10 lines, proportional diameter of last whorl $\frac{5.0}{100}$, height of last whorl $\frac{5.0}{100}$, diameter of umbilicus $\frac{8.5}{100}$. Surface crossed by minute, thread-like lines of growth, extending obliquely backwards from the suture, and then crossing almost directly into the umbilicus.

This little species is easily distinguished from the *M. magna* by its very wide umbilicus (resembling that of the carboniferous *Euomphalus pentangulatus*), and by the more rapidly enlarging whorls, which also separate it from the imperfectly known *M. matutina* and *M. sordida* (Hall), from the calciferous sandstone of New York.

In the concretionary and schistose limestone of Craig Head near Girvan, Ayrshire.

(Col. University of Cambridge.)

Encyliomphalus Scoticus (M'Coy).

Desc. Discoid, flat, of one and a half gradually enlarging, widely separated, spiral whorls; back obtusely subcarinate, rounded, lower side rounded, upper side with a flat space, bounded on each side by one obscure keel, the outer one most distinct; surface crossed by rather distant sharp lines of growth, each pair

with four or five much finer intermediate striæ. Diameter 1 inch 5 lines, proportional diameter of last whorl $\frac{38}{100}$, height $\frac{32}{100}$.

This species is more regularly involute than the *E. Bucklandi* (Portk.), and has the principal keel on the upper side nearer to the beak. There are three or four of the larger striæ in the space of 1 line about the middle of the under side of last whorl.

Not uncommon in the schistose Chazey limestone of Knockdolian quarry, three miles from Ballintrae; also in the calcareous schists of Mullock quarry, Dalquorhan, near Girvan, Ayrshire.

(Col. University of Cambridge.)

CHAPTER XIV.*

CARBONIFEROUS LIMESTONE BRACHIOPODA.

Discina bulla (M'Coy).

Desc. Hemispheroidal, regularly tumid, inflated; base circular; antero-posterior profile nearly semicircular; greatest depth not at the apex, but at about the middle of the length. Surface glossy, smooth, or with very faint, obsolete, obtuse, concentric and longitudinal striæ; a small sulcus extends anteriorly a short way from the apex, which is obtuse, and nearly vertically over the posterior margin. Length $7\frac{1}{2}$ lines, width the same, proportional depth $\frac{4.5}{100}$, distance of apex from posterior margin $\frac{3.5}{100}$.

The remarkably inflated bubble-like form of this species easily separates it from any I know. The beak is very little within the margin. The traces of concentric markings are rather broad and very obtuse lines, scarcely recognizable in the only specimen which has occurred; the traces of very fine longitudinal striæ are only to be seen on one decorticated spot with a lens, the general aspect of the specimen being remarkably smooth.

Reddish sandy bed of limestone at Lowick, Northumberland.
(Col. University of Cambridge.)

Seminula ficus (M'Coy).

Desc. Longitudinally broad-ovate, gibbous; greatest width slightly in front of the middle; lateral margins slightly raised into a tri-undate, wide, flattened wave, towards the entering valve in old specimens (lines of growth indicating a regular margin up to 1 inch long); no distinct ridge extends from this wave towards the beak of the entering valve, but the surface near the front slopes more rapidly away from it towards the lateral edges; on the receiving valve obscure indications of the mesial hollow and bounding ridges extend a short way towards the beak in specimens an inch and a half long; receiving valve evenly tumid, regularly arched from the beak to the front margin; greatest depth about the middle; beak mo-

* The species in this chapter date from the 'Annals' for Dec. 1852.

derate, obtuse, lateral angulation nearly obsolete; perforation large; surface closely granulo-punctate under the lens; dental lamellæ at sides of foramen large, diverging at 45° . Length 1 inch 6 lines, proportional length of entering valve $\frac{90}{100}$, width $\frac{85}{100}$, depth of receiving valve $\frac{28}{100}$, depth of entering valve $\frac{32}{100}$.

The broad-ovate, tumid form distinguishes this easily from the other carboniferous species, as well as the absence of any distinct mesial hollow or emargination of the front in either valve. The punctures of the surface are considerably smaller than those of the *S. virgoides* (M'Coy) or *S. hastata*.

Rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Spirifera fasciculata (M'Coy).

Desc. Longitudinally very broad-ovate; length and width nearly equal, depressed; hinge-line only half the width of the shell; cardinal area rather more than one-third higher than wide; lateral margins horizontal, front margin abruptly raised into a defined, obtusely angular sinus; entering valve depressed slightly, and gently convex on the sides; mesial fold very strongly defined by a sulcus and depression of the surface on each side; convex, very obtusely angular, but not very prominent, having three ridges near the beak, which dichotomize into six as they approach the margin; each side has about seven to nine flat, smooth ridges near the beak, most of which branch into two or three as they approach the edge; the intervening sulci very narrow; receiving valve more convex, moderately gibbous along the middle, sloping rapidly towards the side margins; mesial hollow strongly defined, very deep, narrow, flattened near the beak, widening, and receiving about two plaits on each side of the middle one as it reaches the front sinus. Width of average-sized specimen 9 lines, proportional length of receiving valve $\frac{90}{100}$, of entering valve $\frac{80}{100}$, width of cardinal area $\frac{53}{100}$, width of sinus in front margin $\frac{42}{100}$, depth of ditto $\frac{19}{100}$, depth of entering valve $\frac{15}{100}$, of receiving valve $\frac{35}{100}$; width of very large Irish specimen 1 inch 5 lines, proportional length of receiving valve $\frac{80}{100}$, depth of both valves $\frac{50}{100}$.

Distinguished from the *S. duplicicosta* (Phill.) by the more longitudinally oval, depressed form, very short hinge-line and cardinal area.

Not very uncommon in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Spirifera grandicostata (M'Coy).

Desc. Transversely subrhomboidal, sides abruptly attenuated and flattened, twice as wide as long, moderately convex; hinge-line acute-angled, cardinal area broad, with parallel sides; profile of receiving valve abruptly arched to the incurved beak in the posterior third of its length, much more gently arched in the anterior two-thirds, so that the anterior lobe projects much from the front margin; mesial hollow deep, corresponding ridge moderately prominent; radiating ridges very large, thick, angular, three strongly marked on the mesial hollow, of which the middle is much the broadest and most depressed on the shell; the two lateral are imperfectly and obscurely triplicated towards the margin; corresponding sulci on mesial ridge faintly marked; on each side are about five great angular radiating ridges, some of which show a faint tendency to imperfect division towards the margin; the narrow flattened sides, or cardinal angles, when preserved, show five or six very much smaller obscure radiating ridges. Width about 2 inches 6 lines, proportional length of receiving valve $\frac{5.3}{100}$, of entering valve $\frac{4.5}{100}$, width of cardinal area $\frac{8}{100}$, depth of sinus in front margin $\frac{1.6}{100}$, depth of both valves $\frac{5.0}{100}$.

This is allied to the *S. trigonalis* of Martin, but differs from it by its abruptly narrowed and attenuated sides, and by its few very large angular ridges occupying the body of the shell, and the abrupt diminution in size of the five or six outer ridges on each side. A very young specimen, 9 lines wide, has the three ridges in the mesial hollow distinctly marked, but nearly as large as the lateral ones, of which there are three or four great ones on each side, but scarcely a trace of any additional ones on the flattened cardinal angles, which are strongly striated parallel to the margins.

Rare in the carboniferous limestone of Derbyshire, but common in the Irish limestone at Ardagh.

(Col. University of Cambridge.)

Spirifera paucicostata (M'Coy).

Desc. Globose, or very broad, ovate; hinge-line slightly shorter than the width of the shell; cardinal angles slightly obtuse, sides and front moderately rounded, very obtuse from the meeting of the valves at a large angle, front abruptly raised into a wide semielliptical sinus. Entering valve evenly convex, sides tumid, with six or seven strong, rounded, obtuse simple ribs on each side; mesial ridge broad, prominent, very strongly defined from the beak, having three ridges about the

size of the lateral ones, each of which dichotomizes close to the margin. Receiving valve very gibbous, semicircularly arched from the beak to middle of front margin; mesial sinus deep, strongly defined from the beak, having at first three, subsequently six small obscurely marked ribs; beak very large, incurved; cardinal area moderately wide. Width 9 lines, proportional length of receiving valve $\frac{90}{100}$, length of entering valve $\frac{70}{100}$, depth of both valves $\frac{70}{100}$, width of mesial fold $\frac{47}{100}$, height of sinus in front margin $\frac{22}{100}$, width of cardinal area $\frac{15}{100}$.

This species is most nearly allied to the *S. trigonalis*, from which it is distinguished by the more spheroidal form, the obtuse rounding of the sides, and the very small number of its lateral ribs; the distinctly ribbed mesial ridge separates it from *S. pinguis*, as well as its more depressed form, and the fewer and more prominent radiations.

Not very uncommon in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Hemithyris heteroptycha (M'Coy).

Desc. Transversely oval, very gibbous; hinge-margin obtusely arched, front much elevated into a deep, subquadrate oblong sinus, inclining backwards from the line of the lateral margins at about 80° , which only affects the even convexity of the entering valve near the margin; entering valve evenly gibbous, slightly flattened, or even concave in the mesial line near the beak; profile abruptly incurved at the beak, and rather abruptly curved downwards near the front margin; intervening portion nearly straight, the greatest depth being at about two-thirds the length from the beak; sides very abruptly arched downwards to the lateral margins, which are very slightly sigmoid at the sides, the commissure obtusely angular up to the beak, having on each side of the rostral portion a very slight narrow depression; three mesial ridges occupy the width of the top of the sinus, very large, obtusely angular, deeply indenting the margin, and continued simply to the beak; lateral ribs dichotomizing at from one to two lines from the beak, unequal in size, fifteen or sixteen on each side near the margin, scarcely half the size of the mesial ridges, very strongly arched at the sides; receiving valve with the lateral third on each side, and the rostral portion slightly convex, the middle portion after about two lines long very abruptly curved downwards into a very wide mesial hollow to fill the oblong sinus in the front margin, the profile of the middle being nearly semicircular, the lateral ridges all bifurcate at

about three lines from the beak, the two large mesial ridges simple, having besides a small dichotomous pair on each side in the sinus. Width 6 lines, proportional length of receiving valve about $\frac{8.5}{100}$, length of entering valve $\frac{8.0}{100}$, width of sinus in front margin about $\frac{6.0}{100}$, depth thereof $\frac{5.5}{100}$, depth of receiving valve at middle of side $\frac{2.0}{100}$, greatest depth of entering valve $\frac{4.5}{100}$; the three mid-ridges at margin occupy a space of 2 lines, six of the lateral ones occupy the same space, surface smooth.

The great number of small obtuse dichotomizing plaits on the sides distinguishes this from any of the varieties of *A. flexistria*, *A. ventilabrum*, &c., as well as their extending quite to the beak, and the disproportionally large mesial ridges separate it from the *A. bifera* and *A. cuboides*. I have not seen the dental lamellæ.

Rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Hemithyris longa (M'Coy).

Desc. Longitudinally trigonal, length exceeding the width or depth, greatest width at one-third from the front margin, lateral anterior margins obtusely rounded, front very obtusely angulated in the middle; posterior lateral margins long, nearly straight, converging to the beak at an angle of 80° ; commissure with a slight wave towards the entering valve in the posterior half of the lateral margins; anterior half of the lateral margins nearly straight, with a very faint indication of one plate on each side; middle of the front margin elevated at an angle of 85° with the plane of the lateral margins into a wide tongue-shaped sinus with sigmoid sides, acutely angular in the middle; entering valve with the profile very slightly arched, greatest depth about the middle of the length; sides convex, arched abruptly downwards on each side from the obtuse mesial line; receiving valve flattened or very slightly convex for about three lines from the beak, after which the very narrow sides alone are continued nearly straight to the obtusely rounded anterior lateral angles, the wide mesial portion being strongly depressed to fill the sinus in the front margin; beak rather large, very slightly incurved; surface smooth, with a few obtuse imbrications of growth near the margin; tissue very coarsely fibrous, almost visible to the naked eye; dental lamellæ in beak of receiving valve very short, subparallel, slightly divaricating; mesial septum of entering valve very minute. Length nearly 6 lines, proportional width $\frac{9.0}{100}$, length of entering valve $\frac{9.0}{100}$, depth of entering valve $\frac{4.5}{100}$, depth of receiving valve $\frac{1.5}{100}$, width of sinus $\frac{8.0}{100}$, depth thereof $\frac{5.0}{100}$.

By the great thickening of the margins, it is obvious that this little shell is adult. It only approximates in the most remote degree to one other *Hemithyris* that I know of, viz. one of the varieties of *H. acuminata*, from which it is distinguished by its very small size, and the length exceeding both the width and the depth.

Very rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Pentamerus carbonarius (M'Coy).

Desc. Globose, more or less inequilateral; hinge-line nearly as wide as the shell, cardinal angles obtuse; lateral and greater portion of front margin in one plane; middle of front margin abruptly raised into a very narrow, short, oblong or rounded sinus; commissure blunt from the meeting of the valves at a very obtuse angle. Entering valve varying from semicircular to rhombic, very gibbous; beak large, prominent; profile regularly arched from the apex to its front margin, its greatest depth about the middle of the length; mesial ridge narrow, flattened, prominent, and strongly defined from the front margin to the apex of the beak, either simple, divided by one mesial hollow, or divided into four narrow ridges near the margin, each side with about seven very large, rugged, angular, irregular, subequal ridges, at six lines from the beak, beyond which they either continue simple to the margin, or some or all of them dichotomize: surface rather rugged and very coarsely granulo-punctate, or minutely pustular under the lens, with strong thickened interruptions of growth at the margin after nine or ten lines long. Receiving valve extremely gibbous; beak very large, usually slightly inclined to one side, varying greatly in its inrollment, according to the form of the cardinal area, which is sometimes nearly half as high as wide, triangular, very slightly concave, and nearly at right angles with the plane of the lateral margins, in which case the beak is prominent, and only slightly incurved, the greatest depth of the valve being a little in front of its apex, and the profile arching very gradually from thence to the front margin; in other specimens the beak is inrolled so as nearly to touch that of the entering valve, when the cardinal area is greatly reduced, very concave and lying nearly in the plane of the lateral margins, the profile being more than semicircularly curved; mesial hollow very strongly defined by two thick ridges from the apex to the narrow sinus in the front margin, either simply hollowed, or bearing four ridges, much smaller than the lateral ones; lateral ridges about ten to

twelve on each side at seven or eight lines from the beak, beyond which they are either simple, or more frequently di- or tri-chotomous as they approach the margin, more rugged and irregular in direction than those of the entering valve, varying from three to six in three lines at 1 inch from the beak according to the amount of bifurcation. Internal mesial septum of receiving valve very long, reaching nearly to the front margin, the lines of growth slightly arched towards the beak; rostral divaricating portions scarcely two-thirds the length of the combined mesial portion, but of slightly greater width: two mesial septa of entering valve narrow, scarcely one-third the depth of the mesial septum of the receiving valve; anterior broad ends very obliquely truncated, but reaching rather less than half the length of the valve. Average width 1 inch 2 lines, proportional length of entering valve $\frac{7.5}{100}$, length of hinge-line $\frac{8.7}{100}$, length of receiving valve varying from $\frac{9.5}{100}$ to $\frac{10.0}{100}$, height of cardinal area varying from $\frac{1.5}{100}$ in the former to $\frac{4.7}{100}$ in the latter, width of mesial ridge and sinus in the front margin $\frac{2.5}{100}$, depth of entering valve $\frac{2.0}{100}$ to $\frac{2.5}{100}$, depth of receiving valve $\frac{5.0}{100}$ to $\frac{6.5}{100}$.

Some of the specimens of this species so nearly resemble *Spirifers*, that it was not until I made sections in various directions of several specimens, demonstrating the invariable presence of the two narrow longitudinal subparallel septa in the entering valve, and the wide, extremely long mesial septum in the receiving one, with its internal divaricating portions flanking the triangular opening in the cardinal area, perfectly agreeing with *Pentamerus*, as well as the absence of spiral appendages, that I was convinced of its true genus. I have had the pleasure of demonstrating these specimens to M. de Verneuil, who, like myself, was fully satisfied of their being true *Pentameri*, and saw in them the first example of the genus in carboniferous rocks (the *Pentamerus Sella* and *P. plicatus* of Kutorga being obviously *Camerophoriae*).

Not very uncommon in the impure lower carboniferous limestone of Kendal, Westmoreland.

(Col. University of Cambridge.)

Leptæna (Chonetes) polita (M'Coy).

Desc. Transversely fusiform; hinge-line exceeding the width of the shell, forming narrow semicylindrical convoluted ears, each bearing four or five small spines; receiving valve nearly hemispherical, very gibbous in the middle and towards the beak, which is large, inflated, and seems considerably to overhang

the hinge-line from the abrupt contraction of the ears, which are separated by an abrupt curve from the steeply sloped sides; front margin slightly elevated into a broad wave extending its whole width, no mesial furrow; entering valve almost as concave as the receiving one is convex; cardinal area about ten times wider than high; substance of the shell thick; external surface of both valves perfectly smooth, or under a strong lens, with minute concentric striæ of growth near the margin; internal cast of receiving valve marked with very large quincuncially arranged punctures, usually about twice their diameter apart; rostral portion divided by a narrow slit left by the mesial septum, extending less than one half the length of the shell. Width of large specimen $4\frac{1}{2}$ lines, proportional length of receiving valve $\frac{70}{100}$, depth $\frac{35}{100}$.

This species has much the form of *Leptæna* (*Chonetes*) *volva* (M'Coy), but is not so wide and is more gibbous: it is the only carboniferous species I know at this date that has a smooth surface. The measurements given above are from a large Irish specimen in the collection from the limestone of Mount Rath, the English ones being only 2 lines wide.

Rare in the dark carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Leptæna (*Chonetes*) *subminima* (M'Coy).

Desc. Rotundato-quadrate, length three-fourths or four-fifths the width; receiving valve very gibbous in the middle, greatest depth a little behind the middle; hinge-line as long as the shell is wide, forming flattened ears, slightly acute from the sigmoid outline of the sides, having three or four moderately long slender spines on each side of the beak, extending backward as usual in the plane of the margins; front margin moderately convex; surface uniformly covered with close obtuse striæ once or twice branched, but nearly uniform in size on all parts of the shell, and so fine that twelve at the margin only occupy half a line, when decorticated the impressed lines between the striæ of the surface very coarsely punctured, and the beak slit by the deep impression of the mesial septum extending half the length of the shell; entering valve nearly as concave as the receiving one is convex; surface similar in both valves, the striæ being crossed by fine close lines of growth. Average width $1\frac{1}{2}$ line; the depth seems about half the width.

This little species is so extremely like the Silurian *Leptæna*

minima that it required a comparison of the specimens to distinguish them, more especially as the spines on the hinge-line of the present species are not often seen; the carboniferous fossil has more uniform and less branched striæ, and they are so much finer than in the Silurian species, that double the number is uniformly found to occur in the same space of half a line near the margin. It is possible that this may prove identical with the *Leptæna gibberula* of my volume on the 'Mountain Limestone Fossils of Ireland,' t. 20. f. 11 (which certainly has no relation to my *L. crassistria* and *sulcata*, with which M. de Koninck unites it); but as I there described the width as rather greater, and do not give the absolute dimensions of the fine striæ, I hesitate to unite them without a comparison of specimens.

Very abundant in a piece of the black upper carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Lingula latior (M'Coy).

Desc. Broad-ovate anteriorly, gradually acuminate posteriorly; moderately convex towards the beak, very gradually flattened towards the margins; sides meeting at the beak at an angle of about 75° ; front wide, semielliptically rounded; greatest width at about the middle of the length, from whence the posterior end is rapidly narrowed to the beak; surface with fine, sharply defined, strong, close, elevated, obtuse, concentric striæ slightly irregular from occasional branchings and interruptions, crossed in parts by longitudinal microscopic striæ. Length $4\frac{1}{2}$ lines, proportional width $\frac{80}{100}$.

Distinguished from the other described Carboniferous *Lingula* by the very wide ovate form of its anterior end, and the great comparative length and straightness of the posterior lateral edges, which, by their convergence at so small an angle, give the remarkable posterior attenuation or pointed beak, characteristic of the species.

Not very uncommon in the black limestone over the main limestone of Derbyshire.

(Col. University of Cambridge.)

CHAPTER XV.*

CARBONIFEROUS LIMESTONE FOSSILS.

Pinna spatula (M'Coy).

Desc. Valves very narrow and much elongated, about four times larger than the width of posterior end, very slightly convex except at the beaks, which are pointed and almost cylindrical, the sides gradually flattening as they approach the posterior end, which is subtruncate or slightly rounded obliquely; cardinal margin slightly thickened, with the cartilage ridge very close within its edge; surface perfectly smooth or with very faint laminar lines of growth parallel with the margins. Length of large, rather imperfect specimen $5\frac{1}{2}$ inches, proportional greatest width at posterior end about $\frac{30}{100}$, greatest depth $\frac{8}{100}$ or $\frac{9}{100}$.

Fragments of this species might be taken for a *Solen*, and the *S. siliquoides* (Kon.) may have some affinity with it, though specifically distinct. The muscular impression is rather large, though superficial, quadrato-reniform, rather behind the middle of the length, and nearer to the cardinal than the ventral margin.

Specimens of the above large size, rare in the carboniferous limestone of Derbyshire; specimens about 3 inches long, and slightly more convex, in the carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Cardiomorpha orbicularis (M'Coy).

Desc. Suborbicular; anterior end moderately large, semicircular, compressed; ventral and posterior margin very convex, regularly curved; posterior side small, rounded, gradually compressed; beaks very large, tumid, obliquely inrolled towards the anterior end, projecting greatly beyond the hinge, nearly over which is the deepest part of the shell; valves becoming gradually flattened towards the margins; surface smooth, even; substance of the shell very thin; hinge-margin inflected at right angles, forming a cartilage support rather

* The species in this chapter date from the 'Annals' for Sept. 1853.

less than 2 lines wide. Length 3 inches 2 lines, proportional width from beak to ventral margin $\frac{9.0}{100}$, length of anterior end $\frac{1.8}{100}$, width half-way between the beak and posterior end $\frac{6.5}{100}$, depth (greatest near the beak) $\frac{5.5}{100}$.

This is only likely to be confounded with the *C. oblonga* (Sow.sp.), but is distinguished by its large anterior and small posterior sides, extremely large beaks, and flattened orbicular valves. The *young* of the *C. corrugata* (M'Coy), which is nearly like in form, is distinguished by the large corrugations of the sides.

Seems not uncommon in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Lithodomus Jenkinsoni (M'Coy).

Desc. Longitudinally oblong or oval, subcylindrical; beaks small, much incurved, obliquely inrolled over the wide, deep, cordate, anterior lunette; anterior end very short, extending very slightly in front of the beaks, obtusely rounded; posterior end slightly wider than the anterior, obtusely rounded; dorsal margin nearly straight, gradually rounding into the posterior end; ventral margin very slightly convex; valves evenly tumid, most so along an undefined line from the beaks to the respiratory margin a little in front of the middle of the length; surface with irregular, coarse, concentric lines and plicæ of growth. Casts show the large anterior and posterior adductor impressions distinctly connected by the simple pallial scar, together with faint traces of the concentric plicæ of the surface, crossed by microscopic, close, diagonal striæ from the beaks towards the respiratory margin; also an impression of the small cartilage ridge within the dorsal margin. Length 1 inch 7 lines, proportional depth greatest at middle of length $\frac{4.5}{100}$, depth at posterior end $\frac{4.0}{100}$, from apex of beaks to ventral margin $\frac{2.0}{100}$, length and width of anterior lunette $\frac{1.2}{100}$, greatest depth of both valves $\frac{4.2}{100}$, length of anterior end $\frac{1.0}{100}$.

This is a smaller and much more obtuse species than the *L. dactyloides* (M'Coy), the anterior end being proportionally broader and more obtusely rounded; the posterior end is also less pointed, and the anal angle not elevated. I have not seen the external shell of this species, except near the margins, and here there is no trace of the distinct longitudinal or radiating striation of that species, traces of which are however seen on the internal casts. I dedicate this species to the Rev. Mr. Jenkinson of Lowick, to whose labours we owe the most extensive and beautifully perfect local collection perhaps ever made—particu-

larly instructive by the frequent exhibition of internal characters.

Not uncommon in the impure carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Edmondia rudis (M'Coy).

Desc. Rotundato-quadrate, very gibbous; beaks very large, obtuse, posterior end broad, subtruncate, very slightly oblique; posterior slope flattened, steep, undefined; anterior end subtruncate, abruptly compressed; ventral margin gently convex; hinge-line nearly as long as the shell, slightly raised; middle of the shell with very unequal rugged plicæ, parallel with the ventral margin, anterior and posterior slopes evenly smooth. Length 1 inch 1 line, proportional width $\frac{8.5}{100}$, width of posterior end $\frac{8.0}{100}$, length of anterior end $\frac{1.5}{100}$, depth of one valve $\frac{2.6}{100}$.

The short, quadrate, extremely gibbous form and unequal rugged plicæ distinguish this species from all other carboniferous fossils that I know at a glance. There is often a sort of large obscure pitting between the plicæ. The cardinal cartilage ridge is very thick, and nearly as long as the hinge-line or simple erect cardinal margin.

Rare in the impure carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Murchisonia dispar (M'Coy).

Desc. Elongate, very acutely conic; apical angle 30° ; spire of about eight very gradually increasing tumid whorls having a very thick obtuse prominent band, forming a rounded keel much nearer the lower than the upper suture; upper and lower surfaces slightly tumid, convex, the lower portion most steeply sloped; the band is either simple, or rarely with three spiral striæ; two strong spiral lines below the keel, and six slightly smaller ones above it on each whorl; base of body-whorl rounded, convex, with an obtuse angulation at such a distance below the keel, that it is just concealed by the suture on the spiral whorls; lines of growth five, unequal, obscure, slightly arched, oblique to the band. Length 7 lines, proportional width $\frac{5.0}{100}$, height of last whorl $\frac{4.5}{100}$, height of penultimate whorl $\frac{2.0}{100}$.

This species is easily distinguished from its allies, the *M. sub-sulcata* and *M. Archiacana*, De Koninck, and *M. Larconi*, M'Coy,

by the disparity in width of the parts of the whorls above and below the band, and the disparity in number of the keels or spiral striæ which ornament those parts.

Not very uncommon in the impure carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Pleurotomaria decipiens (M'Coy).

Desc. Var. α. Spire acute, regularly conic; apical angle about 40° ; composed of about seven or eight gradually increasing flat whorls; suture a simple impressed line; base of body-whorl flattened, forming a strong angle with the spire; no umbilicus; pillar-lip slightly thickened, arched; mouth oblong angulated, a little wider than long; surface marked with narrow thread-like spiral ridges, separated by flat or slightly concave spaces about three times their width; about eight or nine spiral ridges on each whorl, and seven or eight more rather stronger on the base, the intervening spaces very irregularly cancellated by obscure, unequal, obtuse, longitudinal wrinkles, very slightly oblique to the band, forming an obscure irregular, quadrate pitting, occasionally visible on the cast, these transverse plicæ closer and more oblique on the base; band about the width of the ordinary spaces between the spiral lines, flat, very inconspicuous, and bounded by very delicate, impressed lines, destitute of the obtuse cancellating plicæ of the rest of the surface, situated two inter-spiral spaces above the lower suture of each whorl. Width 10 lines, proportional height of last whorl $\frac{6.5}{100}$, height of penultimate whorl $\frac{4.0}{100}$, width of mouth $\frac{7.0}{100}$.

Var. β. Very elongate conic; apical angle about 40° ; whorls moderately convex; base of basal whorl gradually prolonged, not flattened nor separated by an angulation from the sides; mouth a little longer than wide. Length of last whorl 11 lines, proportional width $\frac{9.5}{100}$, height of penultimate whorl $\frac{4.0}{100}$.

It will be seen that this species has two extreme varieties somewhat resembling those of the *P. yvanni*; the variety *α.* so exactly resembles a *Trochus*, that it requires the most careful examination to detect the extremely obscure, though definite band, to convince the observer that it is a *Pleurotomaria*; the *var. β.*, with the basal whorl elongate and rounded in front or at base, like the corresponding variety of *P. yvanni*, is so like a *Macrochilus*, that it is only by carefully tracing the intermediate forms and detecting the very obscure band, noting the same number of spiral ridges on the whorls, &c. that I have become satisfied of

their identity; both varieties have usually only four whorls preserved, the posterior end of the animal at that length depositing convex imperforate diaphragms, and becoming naturally decolated.

Both varieties rare in the impure lower limestone of Lowick, Northumberland; the *var. β.* rare in the similar limestone of Kendal.

Pleurotomaria erosa (M'Coy).

Desc. Orbicular, depressed, very obtusely conical; apical angle 105° ; spire of $4\frac{1}{2}$ rapidly enlarging whorls; flattened or very slightly convex; sutures fine, simple impressed lines; body-whorl flattened or slightly convex in the upper two-thirds, the periphery very obtusely rounded, close to the broad flattened gently convex base; umbilicus entirely closed, with a large, very thick, semicircular shelly pad; band narrow, obscure, bounded by two fine impressed lines; surface glossy, eroded with deep, obtuse, excavated markings, without regularity in size, shape or direction; lines of growth arching backwards to the band, scarcely visible. Diameter 5 lines, proportional height $\frac{7.5}{100}$, height of mouth $\frac{6.0}{100}$, space between last and penultimate sutures $\frac{2.0}{100}$, width of umbilical pad $\frac{4.5}{100}$.

The band of this species is often almost invisible on the periphery of the body-whorl, and the lines of growth can only be traced here and there with a lens. The substance of the shell is very thick, and with the glossy surface, general form, and large umbilical pad recalls *Rotella* (*Pithonellus*) very strongly. The peculiar "worm-eaten" appearance of the irregular pitting of the surface is equally marked in the two specimens before me.

Rare in the carboniferous limestone of Lowick.

(*Col. University of Cambridge.*)

Macrochilus limnæiformis (M'Coy).

Desc. Elongate fusiform, very acutely rhomboidal, greatest width at about the middle of the total length, from whence the anterior or basal part is conoidally attenuated or rapidly sloped to the greatly narrowed front of columella, and very rapidly sloped to the suture, which is simple and slightly imbricating; spire very abruptly attenuated, long, very slender; sides very concave in the profile of about six or seven whorls (usually five preserved); apical angle 54° ; surface polished very smooth, with occasionally fine traces of obsolete direct lines of growth; mouth narrow, elongate, contracted before and behind; anterior part of columella very slightly thickened. Length about 1 inch 7 lines, proportional length of mouth of

body-whorl $\frac{7.0}{100}$, width of body-whorl $\frac{5.7}{100}$, width of penultimate whorl $\frac{3.0}{100}$, space between last and penultimate sutures $\frac{1.5}{100}$, width of mouth $\frac{3.0}{100}$.

This beautiful species is so totally distinct in form from any of those described that it is unnecessary to compare them. The very abrupt attenuation of the elongate spire gives so much the outline commonly seen in *Limnaea* as to suggest the specific name: in addition to this remarkable peculiarity, the species differs from its congeners in the conoidal attenuation of the produced front, from the line of greatest width of body-whorl, which is at about one-third its length below the suture.

Not very uncommon in the carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Macrochilus brevispiratus (M'Coy).

Desc. Elliptical, moderately gibbous, most so about the middle of the length; spire about one-fourth of the total length, pointed, of four whorls gently convex in the middle; sutures slightly imbricating; apical angle varying from 82° to 100° ; anterior portion or base produced, moderately convex; surface smooth, with very faint fine striæ of growth visible near the mouth, being scarcely sinuous and very slightly oblique; mouth elongate ovate, indented by the posterior part of the body-whorl; anterior half of columella thickened, arched. Length of rather small specimen 9 lines, proportional length of mouth or last whorl $\frac{8.5}{100}$, width of body-whorl $\frac{6.6}{100}$, width of mouth $\frac{4.5}{100}$, space between last and penultimate sutures $\frac{1.5}{100}$.

The extreme shortness of the spire separates this form from all of the genus at once, except the *M. Michotianus* (DeKon.); from that globose species, it is distinguished by its much more elongate slender form (indicated by the much less proportional width of the body-whorl when compared with the total length), fewer spiral whorls, less convexity, and the whorls sloping gradually to the sutures.

Rare both in the lower carboniferous limestone of Derbyshire, and in the carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Straparollus costellatus (M'Coy).

Desc. Discoidal, depressed, very obtusely conic; spire of rather more than six very gradually increasing whorls, each slightly convex above, strongly indenting the suture, which is an impressed sharp line; apical angle 110° (from the obtuseness of

the apex its angles would be larger in very young specimens); umbilicus very wide, rounded, half exposing all the whorls; base of body-whorl very convex, rounded, with a very obscure angulation at the edge of the umbilicus; periphery narrowed, obtusely rounded; upper surface of the whorls marked with sharp, slightly sigmoid, rather unequal ridges, arched obliquely backwards, becoming abruptly very much finer and more numerous on passing the circumference to the base (ten of the upper ridges in two lines on the body-whorl), each separated from the next by a sulcus about its own width. Diameter 10 lines, proportional height of spire $\frac{4.0}{10.0}$, height of last whorl $\frac{3.6}{10.0}$, distance between last and penultimate sutures $\frac{1.5}{10.0}$, width of umbilicus $\frac{6.0}{10.0}$, width of mouth $\frac{4.0}{10.0}$.

This species is distinguished from its congeners by the beautifully sharp costellation, or transverse sculpturing of the whorls of the spire, which abruptly ceases on the base of the body-whorl, or becomes there confounded with the lines of growth. The inner lip is complete, but thin, as in other species of *Straparollus*, distinguishing them from *Platyschisma*.

Rare in the lower carboniferous limestone of Lowick, North-umberland.

(Col. University of Cambridge.)

Nautilus? costato-coronatus (M'Coy).

I give this provisional name to a fragment too imperfect to allow of full description, but so strongly marked, and unlike all described types, that I wish to call attention to it. The fragment is 7 lines long, and is divided into seven equal chambers, with simple edges; the surface exposed is the periphery, which is broadly rounded, moderately and evenly convex, the sides divided into large conoidal tubercles, each tubercle on one side coincides with one chamber, and there are two chambers between each pair of tubercles, the width of the periphery in our specimen is 6 lines, and it is marked with ten narrow equal cord-like, closely tuberculated ridges separated by slightly wider flat spaces.

It strongly resembles the *N. tuberculatus*, Sow., but is distinguished by the costellation of the surface.

Very rare in the carboniferous limestone of Lowick.

(Col. University of Cambridge.)

Nautilus tuberosus (M'Coy).

Desc. Discoid, greatest width of the whorls at the angle bounding the periphery, which latter is very wide, moderately concave in the middle, and having the angle on each side undu-

lated into large obtuse tubercles (about $1\frac{1}{2}$ inch from tip to tip on last whorl); sides sloping rapidly with slight convexity to the umbilicus; mouth subquadrate, angles rounded, inner side smaller than the other three. Diameter 7 inches 9 lines, width of last whorl 2 inches 2 lines, width of periphery 2 inches 10 lines, at inner edge 1 inch 10 lines, diameter of umbilicus about $3\frac{1}{2}$ inches.

I have not distinctly seen the surface of this very large species, but it seems to be smooth. The comparative flatness and width of the sides, more quadrate mouth, and deeply concave periphery, easily distinguish it from the *N. tuberculatus* (Sow.), which is the only allied form. In the figure in the 'Mineral Conchology' of *N. tuberculatus* (t. 249) there is an apparent concavity of the section of the periphery, but as this did not agree with the inner outline I doubted its correctness, and on writing to Mr. Sowerby he very kindly furnished me with the exact form of the section of the original specimen, proving that the periphery is strongly and regularly round, contrasting in the strongest manner with the present species, which also wants the medial line of the *N. tuberculatus*. I have only indistinctly seen the septa, which seem to be regular, moderately arched, and rather close. The position of the siphon is unknown.

Very rare in the carboniferous limestone of Derbyshire.

(Col. University of Cambridge.)

Orthoceras (Cycloceras) Flemingi (M'Coy).

Desc. Very gradually tapering; section (? broad oval), siphon subcentral, large, slightly excentric; septa numerous, moderately convex, one coinciding with each of the external rings. Surface girt with close, obtuse, prominent, transverse rings, little more than their own diameter apart, undulated by about fourteen or fifteen strong longitudinal costæ, slightly further apart than the transverse rings, so that the oblong intervening spaces are wider than long, and nearly equalling them in thickness, both transverse rings and intervening spaces marked by strong transverse imbricating striæ, six or seven between the centre of one transverse ring and the next. A specimen 5 lines long and 2 lines in diameter at the smaller end has twelve rings.

This species can only be confounded with the *O. (C.) rugosum* of Flem., from which it is distinguished by its much more numerous and closer rings, fewer and larger longitudinal costæ, stronger transverse striæ, and large siphon far removed from the margin.

Very rare in the carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

Orthoceras (? *Poterioceras*) *cornu-vaccinum* (M'Coy).

Desc. Conical, rapidly tapering to an obtusely rounded point, very slightly arched; section perfectly circular throughout; septa very oblique, flattened, slightly convex, moderately approximate, extending much further forward on the inner side of the general curve than on the outer or convex aspect, the lateral edges being very slightly sigmoidal, on account of their obliquity; the septa are broad oval in form, the *longest diameter being in the antero-posterior direction*; siphon large, about its own diameter within the outer edge (corresponding with the convexity of the general curve of the shell). Surface horny in appearance, marked with irregular scratch-like longitudinal markings, and fine, nearly regular transverse impressed lines, separated by rather wider flattened spaces; thirteen transverse striæ in 2 lines at an inch and a quarter in diameter, about twenty in the same space at 9 lines in diameter. Length of average specimen 5 inches 9 lines; 2 inches 3 lines in diameter at the anterior end, and regularly tapering to the obtusely pointed apex in the above length; average distance of the last few septa 2 lines.

The above measurements are of average-sized specimens, although examples occasionally occur a couple of inches long. The general, slightly curved, obtusely pointed, rapidly tapering form, and peculiar horny looking texture have suggested the specific name. The only described fossil it has any resemblance to is the *Cyrtoceras Verneuillanum* of De Koninck (A. F. B. t. 48. f. 6), but it is easily distinguished by that species having a broad oval transverse section, while the section of the present fossil is perfectly circular; and the septa, which from their obliquity appear oval, have their long axis directed in the opposite direction; the curvature is also less in our fossil. Some of the specimens show a very slight contraction at the mouth, which renders it probable that the species belongs to the subgenus *Poterioceras*, with which all the other characters agree exactly and better than with any other section of *Orthoceras*.

Not very uncommon in the carboniferous limestone of Lowick, Northumberland.

(Col. University of Cambridge.)

CHAPTER XVI.*

CRETACEOUS CRUSTACEA.

THE line, to the importance of which I first drew attention in a paper in the 'Annals' for 1849†, on Crustacea, and to which I there applied the distinctive name of "nuchal furrow," has been also recognized more recently by Professor Milne-Edwards, in his late memoir in the 'Annales des Sciences' on the nomenclature of the hard parts of Crustacea, in which memoir he applies to it the name "cervical furrow," and suggests that it indicates two rings in the carapace of most Decapods, instead of only one, as heretofore supposed. As the nomenclature of Professor Milne-Edwards is much more elaborate than that of his predecessors, I adopt it here, in the description of the *Brachyura* in this chapter: the alterations in my former descriptions, necessary to bring them in accordance with the present ones, can be easily made by any interested person studying the French paper referred to.

Hoploparia Saxbyi (M'Coy). See Plate, fig. 1.

Desc. Carapace nearly cylindrical, averaging from the edge of orbit to posterior side margin 2 inches 4 lines, width about 1 inch 3 lines; nuchal furrow very strong, 1 inch 3 lines from edge of orbit, and therefore nearer to it than to the posterior end of carapace; entire *surface* of carapace closely covered with rough, irregularly unequal, pointed granules (averaging five or six in two lines), rather finer on the posterior half: rostrum broad, depressed in the middle, with a slight elevated mesial line, scarcely reaching the nuchal furrow; rising on the sides into two prominent, longitudinal, coarsely tuberculated ridges, from each of which a row of tubercles extends within half an inch of the nuchal furrow; on the outer side of each of these rostral ridges, and distant about half the width of the rostrum, is a similar row of five or six tubercles from the edge of the orbit; *cheek-ridges* very large, prominent, armed with large projecting compressed spines. *Abdominal segments* covered with a granulation rather finer and more

* The species in this chapter date from the 'Annals' for August 1854.

† See *supra*, page 123.

uniform than that of the carapace, but the last segment and middle tail-flap with a much coarser, flattened or squamous tuberculation; transverse suture of outer tail-flap strongly marked, from the great thickness of the basal portion; anterior articular portion of each segment moderately convex, suture dividing it from the posterior portion strong. *Chelæ* very large, extending beyond the rostrum as far as from thence to end of tail-fins, depressed, obtusely carinated at the outer and inner edges, moderately convex in the middle; right hand much narrower than the left, semielliptical, its greatest width (at base of moveable finger) 1 inch, equaling the length of the carpus, or two-thirds the length from the base of moveable finger to the carpal joint; the external margin of the penultimate finger gently arched, nearly smooth, flattened above and below; internal margin of hand and moveable finger straighter than the external one, the former nearly smooth, the latter lobed by five or six very large flattened tubercles; cutting edges of both fingers straight, set with very numerous, small, close, obtuse tubercles; length of the last finger about 2 inches 4 lines; length of penultimate joint or hand, from carpus to tip of penultimate finger, about 4 inches 4 lines: left hand subtriangular, length of carpus to tip of fingers 1 inch 1 line, width at base of penultimate finger 1 inch 3 lines, but the margins, which are nearly straight from the carpus, continue to diverge at about the middle of the fingers, and are thence strongly arched inwards towards each other; length of moveable finger 1 inch 9 lines, cutting edge of both fingers much arched, the points being incurved, each set with one very large bluntly conical tooth at about one-third its length from the apex, and two large rounded teeth at about one-third the length from the base; the inner margin of the hand is lobed by five or six large compressed tubercles, both hands covered with a coarse granulation (averaging three granules in 2 lines), with eight or ten scattered tubercles nearly a line in diameter; carpus on each side trigonal, about 1 inch 3 lines long, having a granulation like that of the hands, and six or eight irregularly scattered tubercles on the upper surface, a little more or less than a line in diameter. Length of tail-flaps 11 lines, entire length of abdomen $3\frac{1}{2}$ inches.

This species is easily distinguished from the only other cretaceous species (*H. longimana*, Sow. sp.) by the much superior size, and by the great width and flatness of the *chelæ*. The beautifully perfect specimen which I figure of this species, was collected by S. M. Saxby, Esq. of Caius College, Cambridge, whose extensive collection of Isle of Wight fossils is so well known through the

labours of Dr. Fitton and others. I have great pleasure in dedicating it to him.

Very rare in the upper White rag beds of the Upper greensand of Bonchurch, Isle of Wight.

(Coll. Mr. Saxby.)

Glyphæa cretacea (M'Coy). See Plate, fig. 2.

Desc. Carapace narrow; cephalic portion long; from nuchal furrow to anterior end of inner tuberculated cephalic ridge exceeding the greatest depth of the carapace, and exceeding the length of the triangle enclosed between the nuchal furrow and the posterior converging extremities of the oblique branchial ridges; space below the outer cephalic ridge on each side and the branchial regions covered with a rather coarse, equal granulation (averaging eight to nine granules in 2 lines). Length from anterior end of inner cephalic ridges to posterior end of carapace on dorsal mid-line, slightly more than 10 lines; from middle of nuchal furrow to same point slightly more than 9 lines; greatest depth at middle of carapace 4 lines.

I do not know any possible modification of Milne-Edwards's nomenclature of the parts of Crustacea, which would enable us to describe the ridges and sulci of the branchial region of a *Glyphæa* in terms indicating any homology with corresponding parts in other *Decapoda*. This is of little importance, however, in the description of the species, as the ridges are similar in all the examples of the genus. I am not aware of any other true *Glyphæa* in the cretaceous rocks. This very rare species is extremely like the *Glyphæa rostrata* (Phill. sp.) of the coral rag on a small scale, but is easily distinguished, besides its smaller size, by the much greater proportional length of the cephalic part of the carapace, or that in front of the nuchal furrow, when compared with the portion behind it. The specimen described was collected by Mr. Livings of St. John's College.

Very rare in the Upper greensand of Cambridge.

(Coll. University of Cambridge.)

NOTOPOCORYSTES (M'Coy).

The judicious researches of Mr. Carter of Cambridge have enabled him to add to the characters I originally published of this genus in the 'Annals,' that there is a notch also in the lower edge of the orbit.

I have detected a specimen in his collection, of the common *N. Mantelli* (M'Coy) with a pea-like swelling on one of the branchial regions on the back of the carapace, indicating no doubt the existence during the cretaceous period of a repre-

sentative of the internal parasitic genus *Bophyrus*, which attaches itself to the internal gills of many Crustacea at the present day, manifesting its presence by the like external symptom.

Notopocorystes Carteri (M'Coy). See Plate, fig. 3.

Desc. *Carapace* elongate, trapezoidal; greatest width (a little behind the mesial furrow) at the posterior of the three large antero-lateral tubercles of the margin; gently convex, depressed. *Nuchal furrow* obscured by the map-like marking on the anterior part of the carapace, but it is moderately deep and extends from between the two posterior marginal tubercles, with an irregular curve backwards, rounding at a moderate angle under the posterior gastric lobes. *Gastric region* very large; *meso-gastric lobe* forming a very narrow linear ridge, nearly from the nuchal furrow quite to the extremity of the rostrum, completely dividing the great proto-gastric lobes; it is destitute of the large tubercles on this part of the other species, the granulation being almost invisible to the naked eye, except along its edges; its posterior end is confluent with the two transversely rounded, subtrigonal, small *posterior gastric lobes*, which also form nearly smooth elevations immediately in front of the nuchal furrow; the *anterior gastric lobes* (coinciding with the origin of the anterior gastric muscles) form narrow obliquely elongated elevations, running along the front margin, from the inner notch of the orbit to the rostrum, along which their anterior ends abruptly turn, rendering it trifid, including the point of the meso-gastric lobe, which they resemble in being nearly smooth and being edged with a line of slightly larger granules under the lens; *proto-gastric lobes* very large, ornamented on each side with a trident-shaped group of three elongate elevated lobes, nearly equidistant in front, and converging towards the small posterior gastric lobes behind, the outer lobe of the three usually disconnected at the base from the conjoined inner two; it has also a small round elevation immediately anterior and external to its anterior end; no distinct *orbital regions*, but the outer angle of the very large orbits forms the anterior of the three lateral tubercles; the very small triangular *hepatic regions*, coinciding with the middle lateral tubercle, have also a small elevated subtrigonal lobe close to the margin; *anterior branchial region* (or space between the nuchal and meso-branchial sulci) forming a broad oblique band on each side, extending from each side of the posterior lateral tubercle to the uro-gastric region; it has one small smoothed elevation at the lateral tubercle, immediately within and in front of which

is a very elongate pear-shaped one, having one side coincident with the nuchal furrow, and a long transverse elongated elevation, extending behind the tapering inner end of the last, angulated in the middle beyond the termination of that lobe, and thence bent abruptly backwards and inwards behind the posterior gastric lobes to the *uro-gastric lobe*, which cannot be distinctly separated from the *cardiac lobe*, but is flanked on each side by the deep lunate hollows, or little fossæ produced by the attachment of the posterior gastric muscles; *posterior cardiac or intestinal region* not distinctly defined from the branchial regions, which latter have a small curved elevated elongation, bordering the inner anterior angle. All these contorted lobe-like elevations on the anterior half of the carapace are very minutely granular, edged by a single row of slightly larger granules, and separated by broad, deep, smooth, concave furrows; the posterior half of the carapace is uniformly minutely granular. Average length 1 inch 2 lines, proportional greatest width $\frac{7.5}{100}$ (often larger).

This very beautiful and distinct species is larger and flatter than the others of the genus, and destitute of the tubercles with which their carapace is marked, by which character, as well as the very curious, slightly elevated, map-like, contorted, lobular markings of the anterior half of the carapace, it is easily distinguished from its congeners. It is comparatively rare, scarcely a dozen specimens having been found, while nearly a hundred have been found of the *N. Mantelli* (M'Coy).

Upper greensand of Cambridge.

(Coll. Mr. Carter, Cambridge.)

REUSSIA (M'Coy), n. g.

Gen. Char. Small: *carapace* moderately tumid; transversely elliptical, front very strongly rounded; anterior lateral margins obtuse; *orbits* of moderate size, broad-oval, approximate: most of the regions of the carapace sharply defined by narrow sulci; *meso-gastric lobe* triangular behind, abruptly narrowed to a linear tongue-shaped extension in front, reaching to the point of the obtusely angular rostrum, where its apex is flanked by two small oval swellings, indicating the *anterior gastric lobes*; *proto-gastric lobes* large, slightly defined on their outer margin; *posterior gastric lobes* united into one transversely oblong space, slightly wider than the base of the meso-gastric lobe, flanked at its posterior corners by the two lunate fossæ of the posterior gastric muscles; *uro-gastric and cardiac regions* undefined, tumid; *posterior branchial regions* much depressed; *anterior branchial or epibranchial lobe* or

region triangular, tumid, corresponding with the lateral angle, and greatest width of the carapace, and defined between the narrow sharply-marked linear nuchal furrow, and an oblique *meso-branchial sulcus*, extending from about its middle to a little below the lateral angle of the carapace; *meso-branchial regions* narrow, strongly depressed in their posterior half; *hepatic regions* very large, evenly tumid; *pterygostomial regions* very tumid; *orbital regions* undefined, two notches in the upper edge of each.

This genus belongs clearly to the true *Brachyura*, which are so rare in the fossil state, but is distinct from every living or fossil generic type with which I am acquainted. The types of the genus are the following species, and the *Podophthalmus Buchii* of Reuss (*Versteinerungen der Böhmischen Kreideformation*, p. 15).

The reference to the genus *Podophthalmus* (Desmarest) by Reuss rested upon very slight foundation, as is shown by his remark, that the rare specimen of this little crab which he found "stets mit ihrer Bauchfläche fest ins Gestein eingewachsen, so dass sich nur der Rückenschild sehen liess. Auch die Augen konnten nicht untersucht werden. Deshalb ziehe ich sie auch nur mit Zweifel zu der obengenannten Gattung, mit der sie sonst ganz gut übereinstimmt." I have now observed the orbits, and find they completely negative the reference of the fossils to *Podophthalmus*, for instead of forming extremely long narrow channels, extending to the lateral angle, or widest points, of the carapace, they are small, broad-oval, and the long diameter is about double the short one; the forms of the various regions on the carapace are also quite different, as well as the general outline, from the great curvature of the front in the fossil, and consequent shortness and outward slope of the posterior lateral margin.

Reussia granosa (M'Coy). See Plate, fig. 4.

Desc. The general form of the carapace as in the generic character; front and anterior lateral margins very strongly curved, so that the lateral angles are on a line with the gastric fossæ, the tumid, very slightly angulated edge bearing five or six irregularly placed, small, distinct tubercles between the orbit and lateral angle; *hepatic region* much larger than the proto-gastric lobes; *meso-gastric lobe* very sharply defined, by deep narrow impressed outlines; line between the proto-gastric and hepatic lobes very faint; nuchal furrow as a sharp, distinctly impressed narrow line, extending from the base of the meso-gastric lobe to immediately in front of the second tubercle

from the lateral angle, having a slight backward curve; *epi-branchial lobe* pyriform, tumid, defined by the meso-branchial sulcus, which extends from the inner third of each side of the nuchal furrow to as far below the cardinal angle on the outer margin as the nuchal furrow is above it; *meta-branchial sulcus* on each side forming a sharply impressed line like the others; all the dorsal surface tumid, except the posterior half of the meso-branchial lobes, and the posterior branchial lobes, which are strongly depressed; *surface* strongly and closely granulated irregularly, the granules being of three or four different sizes; a few small tubercles like those on the anterior margin also occur, one being conspicuous on each side, slightly below the middle of the furrow which separates the proto-gastric from the hepatic lobes, and two on each side on the meso-branchial region a little within the middle. Width of carapace 10 lines, length $5\frac{1}{2}$ lines, transverse length of one orbit $1\frac{1}{2}$ line, depth of middle of hepatic region 3 lines.

The coarsely granular surface easily distinguishes this species from the smooth and glossy *B. Buchii*, Reuss sp. The anterior lateral margins are also strongly curved. There is a third species in the University collection at Cambridge, distinguished from the other two by a very fine uniform granulation of the surface, but it is not sufficiently perfect for description; it might be called *R. granulosa*.

Rare in the Upper greensand of Cambridge.

(Coll. Mr. Carter, Cambridge.)

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